Baltimore Regional Environmental Impact Study
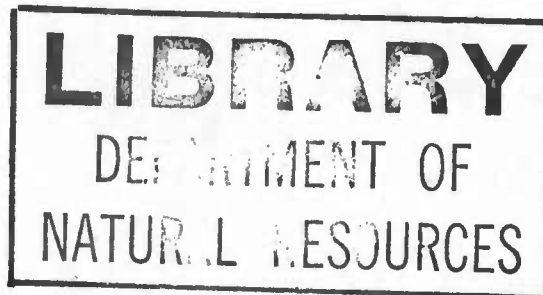
Technical Memorandum No. 6
Analysis of Environmentally Sensitive Areas

Alan M. Voorhees & Associates, Inc. ● Jason M. Cortell and Associates, Inc.

BALTIMORE
REGIONAL
ENVIRONMENTAL
IMPACT
STUDY

TECHNICAL MEMORANDUM NO. 6

ANALYSIS OF

ENVIRONMENTALLY SENSITIVE AREAS

Prepared for

THE INTERSTATE DIVISION FOR BALTIMORE CITY

March 1974

By

ALAN M. VOORHEES & ASSOCIATES, INC.
McLean, Virginia 22101

In Association With

JASON M. CORTELL AND ASSOCIATES, INC.

PREFACE

This memorandum, the sixth of a series of seven technical memoranda on the Baltimore Regional Environmental Impact Study (BREIS) prepared for the Interstate Division for Baltimore City (IDBC), describes the assumptions, methodology, and findings for the analysis of environmentally sensitive areas.

The other technical memoranda are:

- 1 -- Socioeconomic and Land Use Analysis
- 2 -- Travel Simulation and Traffic Analysis
- 3 -- Air Quality Analysis
- 4 -- Water Resource and Solid Waste Analysis
- 5 -- Noise Analysis
- 7 -- Summary Analysis and Evaluation

In addition to IDBC, the Baltimore Regional Planning Council and the Maryland Department of Transportation, including the Mass Transit Administration, have been active participants in the study. Other agencies which have assisted in the project include:

- Maryland Department of Health and Mental Hygiene, Bureau of Air Quality Control

- Maryland Department of Natural Resources

- Maryland Department of State Planning

- Baltimore City, Department of Planning

- Baltimore City, Department of Transit and Traffic

- Baltimore City, Department of Health

- U.S. Federal Highway Administration

- U.S. Environmental Protection Agency

Undertaking the effort was a multidisciplinary team consisting of Alan M. Voorhees & Associates, Inc., with overall responsibility for the study, in conjunction with:

- ESL, Inc. -- Noise Analysis

- Jason M. Cortell and Associates, Inc. -- Environmentally Sensitive Areas

- Economics Research Associates -- Economic Analysis

- Dr. David Marks, Resource Analysis, Inc. -- Water Resources & Solid Waste

- Dr. Gerhard Israel, University of Maryland -- Meteorology

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I. BACKGROUND

This study, initiated in the spring of 1973, was the culmination of a series of events related to transportation systems planning and highway construction that had occurred over a number of years in the Baltimore region. The following brief statement outlines the events leading up to the study to provide a context within which the results of the study should be reviewed.

The highway system which is the subject of this study was defined in a previous comprehensive study of the Interstate plan in Baltimore by Urban Design Concepts Associates, (1) as well as in several other planning studies that preceded it. (2) This system, shown in Figure I-1, is known as the 3-A system. It was adopted in 1969 by the Baltimore Planning Commission and subsequently approved by the Regional Planning Council (RPC) for inclusion in the General Development Plan. The 3-A system consists of several segments of I-70N, I-83, I-95, the I-395 and I-170 spurs, and City Boulevard, an arterial link not on the Federal Interstate System. In the spring of 1973, the following portions of the system were complete:

- I-70N was constructed to the City line

- I-95 was constructed to Caton Avenue just inside the City line on the south and was under construction on the east side in the vicinity of the Harbor Tunnel Thruway to O'Donnell Street

- I-83 (Jones Falls Expressway) was constructed on the north to a point near Eager Street.

In addition, several other segments had received design approval.

With the passage of the National Environmental Policy Act of 1969 (NEPA), many of the environmental concerns which had been expressed by various groups in the Baltimore region received official recognition. Section 102(2)(C) of this act requires a detailed statement for any proposed federal action affecting the environment, including:

- The environmental impact of the proposed action

- Any adverse environmental effects which cannot be avoided should the proposal be implemented

Figure I-1. Baltimore 3A System

Figure I-1. Baltimore 3A System

BALTIMORE CITY

I-70N

I-83

I-170

CITY
BOULEVARD

I-70N

I-95

I-395

I-95

I-95

Sections Completed or
Under Construction
Planned
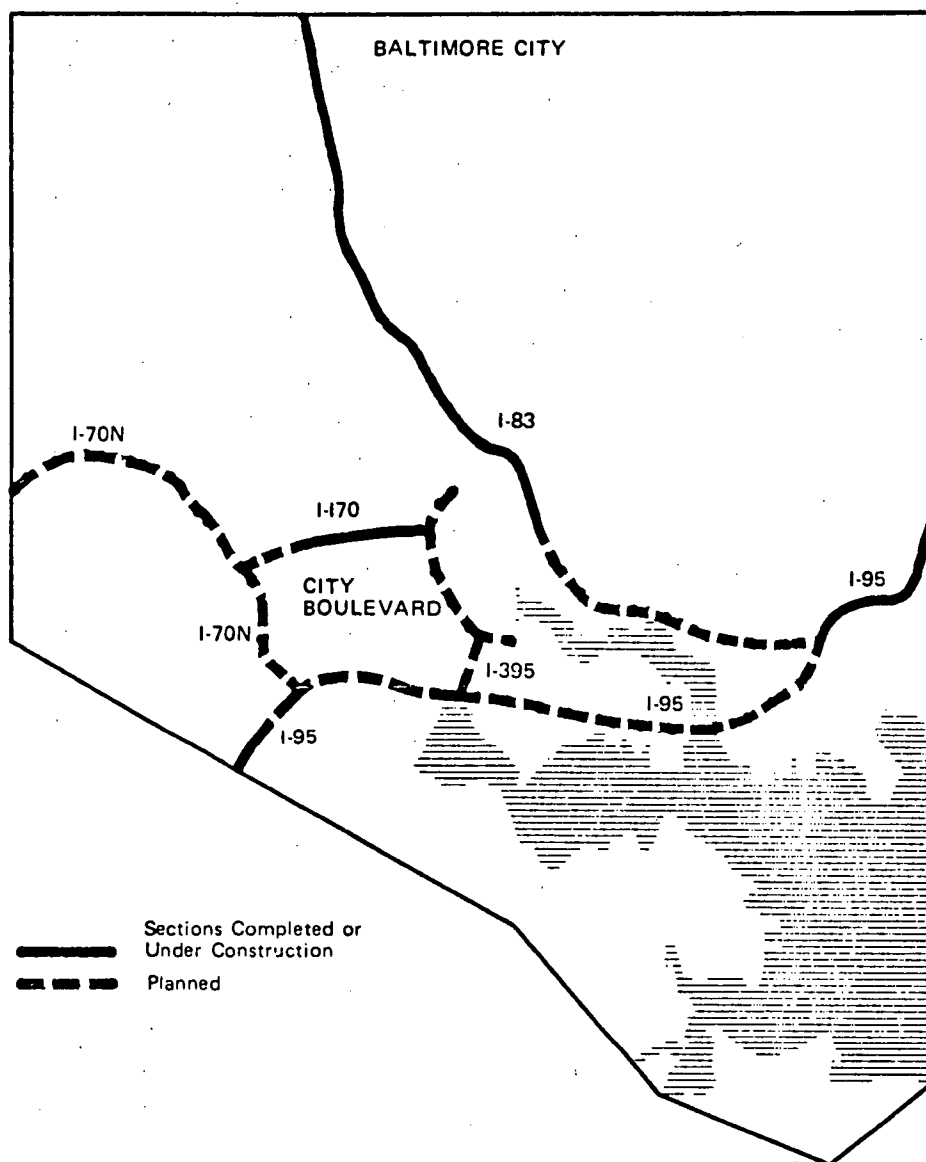
- The relationships between the local short-term uses of man's environment and the maintenance of long-term productivity

- Any irreversible and irretrievable commitments of resources that would be involved in the proposed action should it be implemented

For federal highway construction, these requirements were reinforced by provisions of the Federal-aid Highway Act of 1970 (Section 136), the Department of Transportation Act as amended (Section 4(f)), the Clean Air Act Amendments of 1970, and the Historic Preservation Act of 1966. The Federal Highway Administration (FHWA), in its Policy and Procedures Memorandum 90-1, has directed that these provisions be fulfilled by highway agencies for each highway construction project.

In response to these new requirements, the Maryland Department of Transportation (MdDOT) has submitted a draft environmental impact statement (EIS) for each segment of the 3-A system as it reached the location and design approval stage. The segments of the 3-A system for which environmental impact statements have been prepared are shown in Figure I-2.

However, a citizen suit was filed in 1972 against the U.S. Department of Transportation (Movement Against Destruction (MAD) vs. Volpe) charging that the 3-A system as a whole represented a significant federal action and that a regional environmental impact statement should be filed in addition to separate statements for each facility. Another question, relating to the Franklin-Mulberry Corridor (I-170) asserted that the EIS process had not been sufficient to meet NEPA and other federal requirements. Rights-of-way had been purchased in this corridor, and the City would be required to return over $5 million to FHWA if construction on this segment did not begin by June 30, 1973.

Two other cases (Sierra Club, Inc. vs. Volpe and Lukowski vs. Volpe), also questioning the adequacy of the EIS process, were then pending in the courts. It was agreed that the relevant portions of all these cases would be heard concurrently on April 16, 1973.

As a result of this hearing, the court found on June 22, 1973 that "the applicable law does not require that an environmental impact statement be prepared for the 3-A system as such". Further, "components of the 3-A system are not necessarily so interdependent as to require the construction of all the 3-A system or none of it." The court continued that:

Figure I-2. Environmental Impact Statements (EIS) on 3A System

BALTIMORE CITY

4(f)

4(f)

4(f) H

H

4(f)

H

4(f)

H

••••••• Draft EIS
━━━━━ Final EIS
4(f) Parkland
H Historic Area
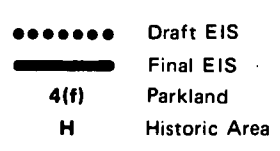
It may be wise for the city, state and federal authorities to prepare
in the near future a statement which considers those environmental
impacts that should be determined with respect to the entire con-
figuration, or major portions thereof. Such a statement would be
included in one or more of the EISs which will have to be prepared
in the future for other sections of the highways in the 3-A system
and which will, of course, also include and consider those environ-
mental impacts that should properly be determined section by section
or road by road. (3)

As a result of this decision, construction began in the disputed section
of the Franklin-Mulberry Corridor on June 22, 1973.

Concurrent with the legal contest, the U.S. Environmental Protection Agency
(EPA) was stressing the need for a regional environmental analysis for
the 3-A system. In September 1972, based on a series of discussions,
a consensus agreement between EPA and FHWA was reached. This agreement
provided in part:

- For all remaining segments of the 3-A system under environmental
  review neither PS&E (plans, specifications and estimates)
  approval nor further right-of-way approval would be granted
  by FHWA until a regional impact consideration statement was
  prepared and circulated to FHWA, EPA, the U.S. Department
  of Transportation, and the Maryland Department of Health
  and Mental Hygiene, Bureau of Air Quality Control (BAQC).

- That the regional impact consideration statement will address
  those regional issues, identified by EPA in its various reviews,
  that cannot be addressed on a project basis and will include
  as a minimum:

    1. Cumulative (regional) air pollution impact of the various
       stages of completion of the currently envisioned 3-A
       system (including the MTA system) in the years 1978,
       1980, 1985, and 1990.

    2. A detailed discussion of possible modifications to the
       proposed system to mitigate air pollution problems.
       The effect of these changes on land use and local traffic
       patterns should be discussed. These modifications
       should include the options of:

-   Increased highway access to the MTA system
-   Impact of elimination of various segments of
    the 3-A system
-   Optimization of construction scheduling to minimize
    saturation of local street systems
-   Impact of the no-build-alternative

It is in response to these actions and the desire of regional and local agencies
to understand the socioeconomic, traffic, and environmental implications
of the 3-A plan that the study presented in this series of reports is directed.

STUDY ORGANIZATION AND PLAN

The study was programmed for completion in approximately six months.
The conduct of the study, under the direction of the Interstate Division
for Baltimore City (IDBC), was a joint effort by the consultant team and
other regional and local agencies. Some of the work for this study was
accomplished by RPC and MdDOT, with assistance from AMV, as part
of the "3-C" (cooperative, comprehensive, and continuing) planning pro-
cess element of the Unified Transportation Planning Program in the Baltimore
region.

The study process outlined in Figure I-3 was directed toward the measure -
ment of several regional environmental features through which the examination
of the estimated future impacts that the 3-A system would have on:

-   Socioeconomic and land use factors

-   Traffic and travel demand

-   Air quality

-   Noise pollution

-   Water resources and solid waste

-   Ecologically sensitive areas

To provide a basis for determining the extent to which future environmental
conditions were related to the 3-A system as opposed to other factors,
such as growth in population, the environmental consequences of several
alternative transportation systems, including a "no-build" option, were
also studied. These alternatives were devised jointly by the various agencies
associated with the study, both as alternatives to the 3-A system and as
a basis for determining the regional environmental consequences of major

Figure I-3.

BREIS-PROCESS FOR EVALUATION OF ALTERNATIVES
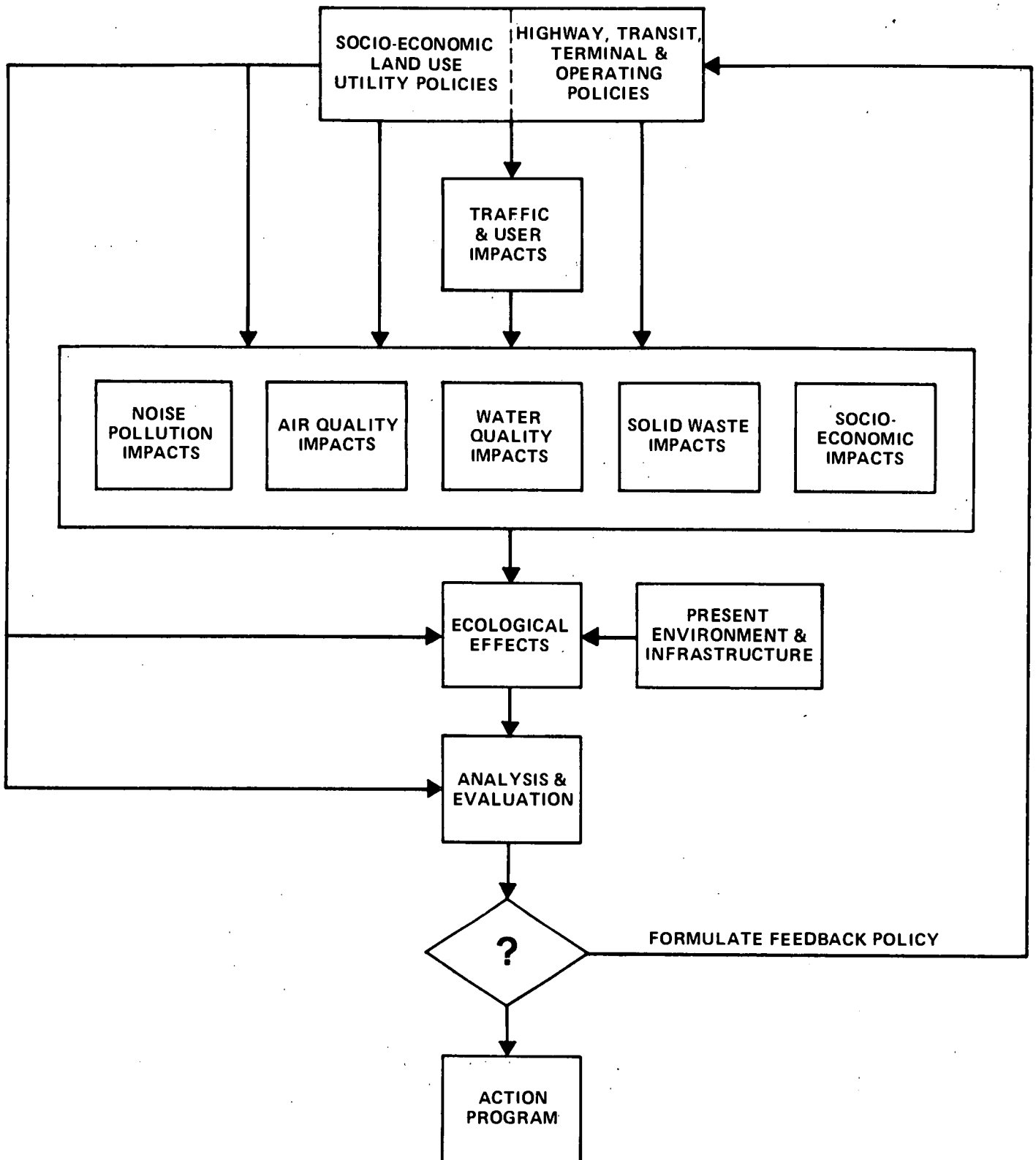
components of that system. These alternatives were selected to isolate various conditions and assess their impact on the region. One of the significant features of this procedure is that land use and socioeconomic activity policies were varied separately for each transportation alternative studied. This permitted an assessment of the predicted effects of changes in urbanization due to transportation policy on the region and demonstrates the interrelationships between transportation and land use.

The study area includes the jurisdictions represented in the RPC -- Baltimore City, and Baltimore, Anne Arundel, Carroll, Harford, and Howard Counties, as shown in Figure I-4. A comprehensive General Development Plan (GDP), which includes a land use pattern element, was adopted for the region in December 1972. It includes the full 3-A system, numerous freeways and other highways outside the City of Baltimore, and a regional rapid transit system comprised of six major lines. This plan serves as one alternative and is the basis for the examination of alternative transportation and land use assumptions for future years.

DESCRIPTION OF ALTERNATIVES

The transportation and land-use alternatives studied consist of three systems for 1980 and four systems for 1995. These alternative systems are shown in Table I-1 and are briefly described below. A tear-out copy of Table I-1, which can be used as a reference while reading this report, can be found at the end of Chapter I.

Originally the study plan included a 1978 system for analysis based on the premise that all of the 3-A system except the Fort McHenry bypass could be completed by 1978; however, since the Phase I rapid transit lines would not be completed until 1980 and since revisions to contemplated construction schedules by IDBC have made the 1978 date meaningless, this was eliminated in favor of analyzing the no-build system in 1995. RPC and MdDOT will continue the analysis for 1978, if necessary.

Phase I rapid transit will consist of 28 miles of rail running northwest to Owings Mills and south to Glen Burnie. All 1980 alternatives include the Phase I rapid transit; all 1995 alternatives are based on the GDP and include the full 6-legged rapid transit system, as well as an augmented bus system.

The differences among the 1980 alternatives are related to the 3-A system--in Alternative 3 the full 3-A system is assumed to be completed; in Alternative 4 the 3-A system will be completed except for the Fort McHenry Crossing; and only existing Interstate facilities or those under construction

I-8

Figure I-4. Study Area—Baltimore Regional Environmental Impact Study
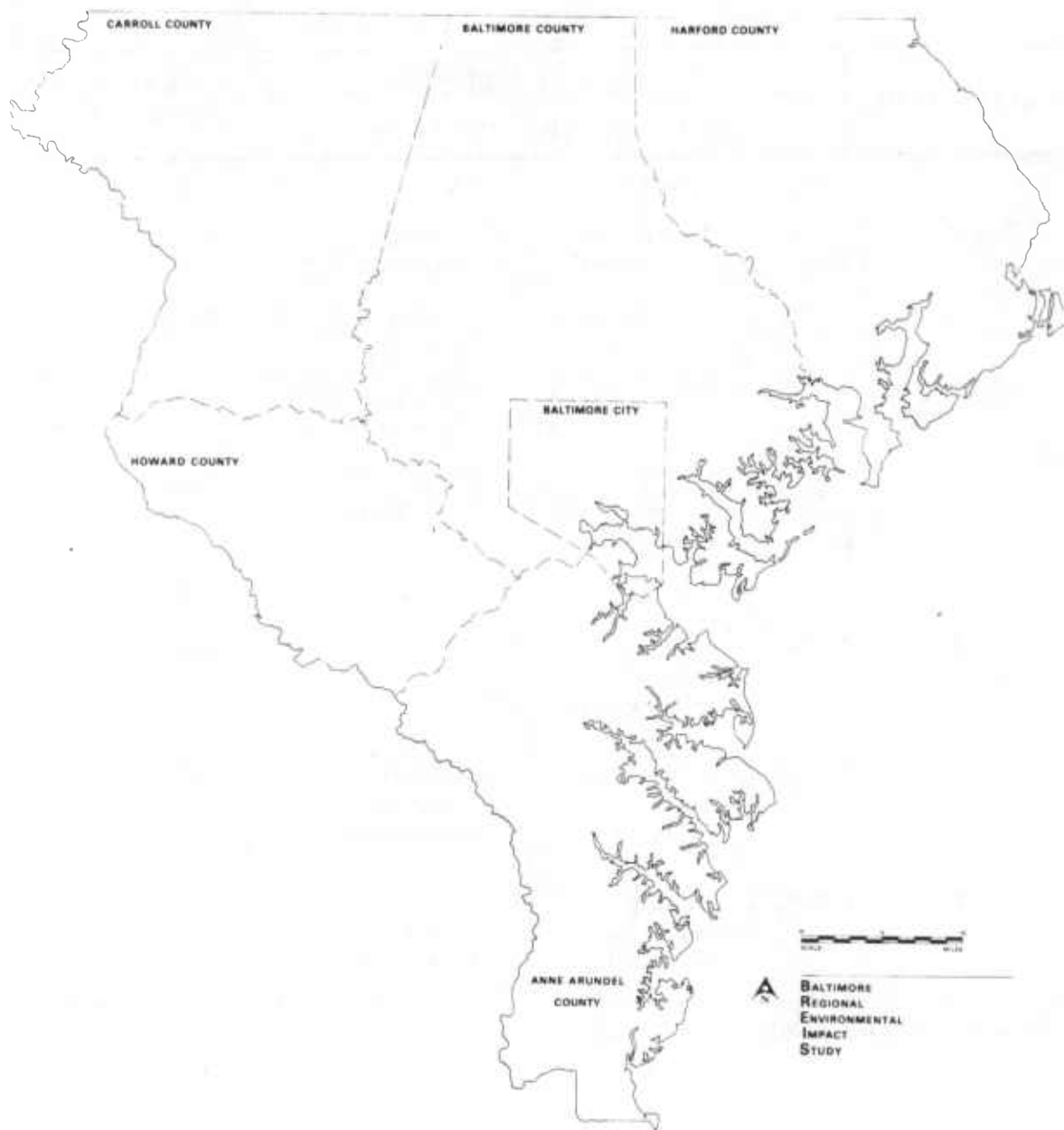
Table I-1.

TRANSPORTATION ALTERNATIVES FOR BALTIMORE REGIONAL ENVIRONMENTAL IMPACT STUDY

ALTERNATIVE	YEAR	HIGHWAY ASSUMPTION		RAPID TRANSIT ASSUMPTION
		3-A INTERSTATE	OTHER HIGHWAYS	
1	1970	Existing	Existing	None
*2	1978	Existing and Programmed	Existing and Programmed	Phase I
3	1980	Complete	Existing and Programmed	Phase I
4	1980	Partial	Existing and Programmed	Phase I
5	1980	Existing and under construction	Existing and Programmed	Phase I
6	1995	Complete	GDP	GDP
7	1995	Existing and under construction	GDP	GDP
8	1995	Complete	Existing and under construction	GDP
9	1995	Existing and under construction	Existing and under construction	GDP

*Eliminated in favor of Alternative 9.

were assumed in Alternative 5. Other programmed highway improvements which were assumed to be operational by 1980 include the Northwest Freeway and the Outer Harbor Crossing which is part of the Baltimore Beltway (I-695). The John F. Kennedy Expressway (I-95) northeast of Baltimore has been widened since 1970.

In 1995, the differences concern not only the 3-A, but also other planned GDP highway improvements. Examples include, in addition to those completed in 1980, construction of the Perring Freeway northeast of the City; upgrading and extension of U.S. 29 and the southern portion of Maryland Route 3; and widening of other facilities including U.S. 40, the Baltimore-Washington Parkway, U.S. Route 1, the Arundel Freeway, and Hilton Street in Baltimore City.

Alternative 6 includes the completed 3-A system and other GDP highway improvements while Alternative 7 includes GDP improvements with the exception of the 3-A system. Alternative 8 includes the 3-A, but no other GDP highway improvements except those under construction. Alternative 9 does not include either the 3-A or other GDP highway improvements except those under construction.

GENERAL ASSUMPTIONS AND DEFINITIONS

A number of assumptions have been made jointly by IDBC and the study team throughout the conduct of this study. Those which relate to specific areas are stated and described in the appropriate technical memorandum. One general assumption is that no special transportation control strategies to reduce air pollution, except Federal Motor Vehicle Controls, are represented in any of the alternatives. At the time of the study no State Implementation Plan to reduce mobile source emissions in the Baltimore region had been formally adopted.

For purposes of analysis the region was divided into 94 Regional Planning Districts (RPDs) and the urbanized area was further divided into 498 transportation zones. The transportation analysis is concentrated within the area comprising the 1964 Baltimore Metropolitan Area Transportation Study (BMATS) as shown in Figure I-5.

STUDY RESULTS

The purpose for the Baltimore Regional Environmental Impact Study has been outlined in the preceding discussion. The role of the study in the region has been stated in the U.S. District Court decision of June 22, 1973 (3):

Figure I-5. BMATS Study Area
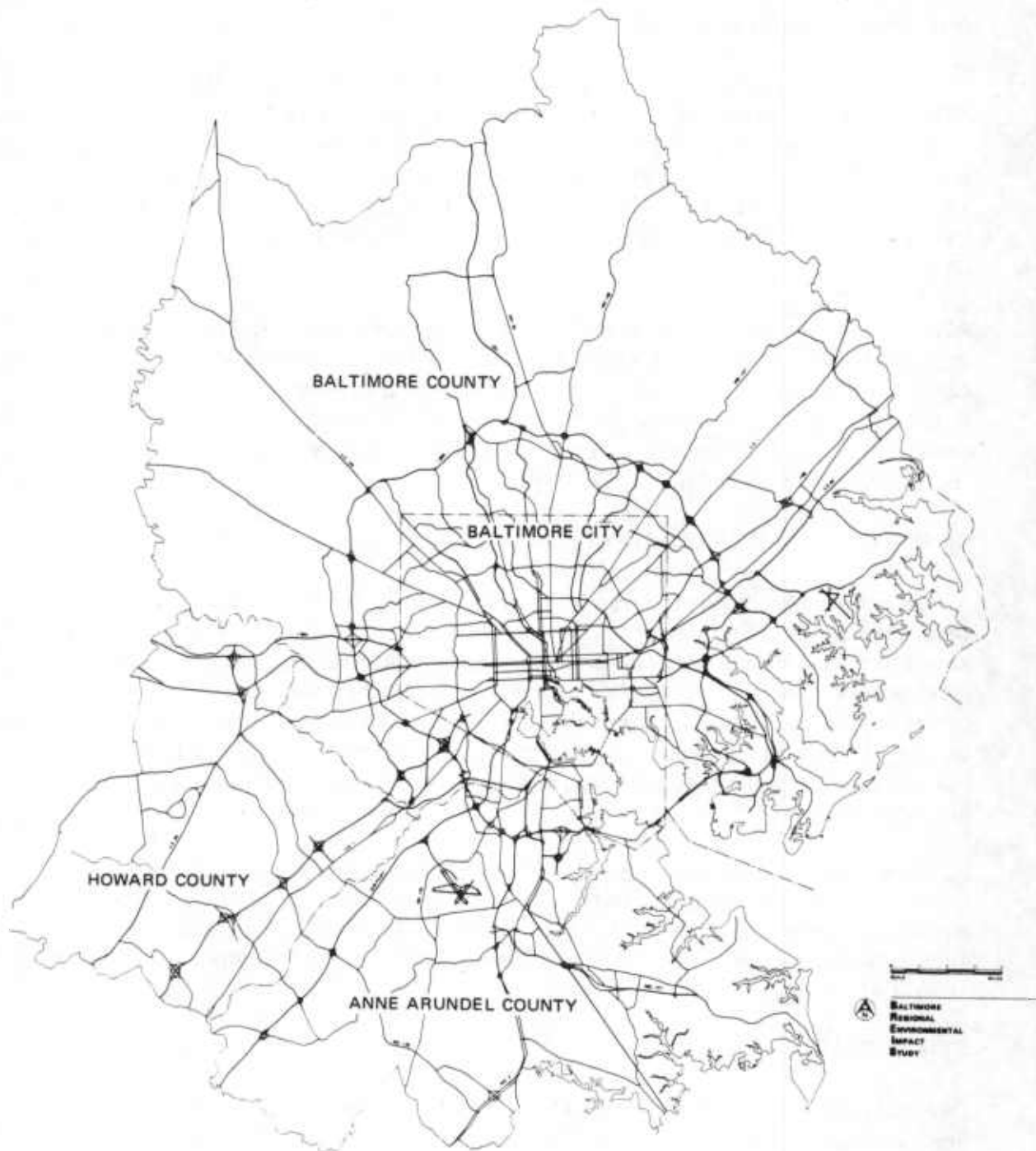
The study has developed into a future planning tool for RPC and Maryland DOT. Many state agencies, such as State Planning, State Health, City Planning and City Health, in addition to RPC and Maryland DOT, will have a use for the study when completed. It will be a data base and data resource document that can be used for possibly setting future transportation policies and other policies within the Baltimore Metropolitan region.

The study results will be framed to answer the following broad questions:

- What were the regional environmental problems in 1970?

- Will there be regional environmental problems in the short-term (1980) with the 3-A system? Without the 3-A system?

- Will there be regional environmental problems in the long-term (1995) with the 3-A system? Without the 3-A system? With the GDP highway plan?

- What are the regional differences between alternatives?

- What regional effects can be attributed to the 3-A system?

- Is there a need for further study?

LIST OF REFERENCES -- CHAPTER I

1. Urban Design Concept Associates, "Transportation, Environmental, and Cost Summary -- An Evaluation of Three Concepts for Expressway Routes in Baltimore City," 1968. (Supported by a series of reports on route segments).

2. Wilbur Smith and Associates, "Baltimore Metropolitan Area Transportation Study," 1964.

    Alan M. Voorhees & Associates, Inc., "Travel Forecasting and Patronage Estimates for Baltimore Region Rapid Transit System," July, 1968.

    Alan M. Voorhees & Associates, Inc., "Update of Patronage, Revenue, and Operating Costs for Phase I, Baltimore Rapid Transit System," January, 1971.

3. Movement Against Destruction v. Volpe, Civil N. 72-1041-M (D. Md., filed June 22, 1973).

TRANSPORTATION ALTERNATIVES FOR BALTIMORE
REGIONAL ENVIRONMENTAL IMPACT STUDY

ALTERNATIVE	YEAR	HIGHWAY ASSUMPTION		RAPID TRANSIT ASSUMPTION
		3-A INTERSTATE	OTHER HIGHWAYS	
1	1970	Existing	Existing	None
*2	1978	Existing and Programmed	Existing and Programmed	Phase I
3	1980	Complete	Existing and Programmed	Phase I
4	1980	Partial	Existing and Programmed	Phase I
5	1980	Existing and under construction	Existing and Programmed	Phase I
6	1995	Complete	GDP	GDP
7	1995	Existing and under construction	GDP	GDP
8	1995	Complete	Existing and under construction	GDP
9	1995	Existing and under construction	Existing and under construction	GDP

*Eliminated in favor of Alternative 9.

II. OVERVIEW

The Baltimore region consists of the City of Baltimore and five adjoining counties -- Baltimore, Anne Arundel, Howard, Harford, and Carroll. Except for deliberately reserved space such as park land, the city is highly developed, with an average 1970 population density of about 18 persons per acre. Population densities in the five counties, on the other hand, ranged in 1970 from 1.75 in Baltimore County to 0.24 in Carroll County. Thus, a great deal of the area of the region is undeveloped and rural in character.

The area's resource base is susceptible to degradation by unplanned development associated with population growth. Such growth (and population redistribution) is often concomitant with major transportation programs, such as the introduction of rapid transit systems and new highway networks.

This study examined the region to establish which areas were environmentally sensitive to development. The inventory concentrated on the three resource categories felt to be especially subject to degradation as the result of population intrusion and accompanying development:

- Geological-physical
- Biological
- Water quality

The survey was limited to resource items which were distributed in a non-random fashion throughout the region. Since, for planning purposes, the region has been divided into 94 Regional Planning Districts (RPDs), these synthetic geographic areas were used as the basic unit for analysis. Each RPD was rated in terms of its sensitivity to development in each of the three resource categories mentioned above. From these, a combined sensitivity rating for each district was then derived and expressed in numerical terms on a scale from zero to three.

Predicted population impacts on each district were provided for each transportation alternative studied. Using a rating scale based on initial population density and expected change, numerical values of a population impact index were established for each district, also expressed on a zero to three scale.

The product of district sensitivity index and population impact index was used to derive an aggregated environmental impact index for each district for each transportation alternative considered. These are displayed in tabular form and on maps within this report.

The basic assumptions underlying this process were:

- Regional impacts consist of secondary, distributed impacts; direct impacts associated with highway construction and operation were excluded.

- Resources that were distributed uniformly throughout the region were also eliminated; it was felt that only non-randomly distributed resources would be subject to differential impact.

- Environmental impact arising from transportation alternatives is a function of development associated with population growth generated by the transportation system and the basic environmental sensitivity of the area affected.

The results of the analysis of the 1980 alternatives show remarkable uniformity. While there is predicted population growth over 1970 associated with all alternatives, there is very little difference between the alternatives. Without the 3-A system, population in the City is predicted to decline somewhat more than with complete or partial construction of the 3-A system. Population growth is larger for this case in Anne Arundel, Carroll, and Harford Counties than for the other 1980 alternatives. Growth in Howard County is somewhat less for this alternative than for the other two, however. The Baltimore County population projections vary only slightly among the three alternatives.

On a regional basis, a smaller population growth is predicted for the plan that does not include the 3-A system than for either of the others. However, the total expected environmental impact for this case was somewhat higher than for the other two. This suggests that it is the distribution of population which is more important than its absolute magnitude. The data also suggest that the 3-A system will not have a marked regional environmental impact in 1980.

These conclusions are borne out by the results for the 1995 alternatives which considered the impacts of highway improvements, including the 3-A system in accord with the General Development Plan. Regional population growth was greatest for the alternative in which the 3-A system and all other GDP improvements are made and least for the no-build alternative. Growth is greater for those alternatives involving the 3-A system than for those which do not include it. The GDP highways appear to make a greater contribution to population growth in the counties than does the 3-A system, especially in Harford and Carroll Counties.

Impacts on the environmentally sensitive areas are greatest for the full system, which includes the 3-A and GDP improvements, closely followed by the alternative that has the GDP improvements in the counties but has no 3-A system. The least impact was that associated with the no-build alternative. In this case, aside from any contribution attributable to the rapid transit system, the impacts represent simple population growth.

The impacts relative to the no-build alternative may be summarized as follows:

- Construction of the 3-A system only leads to an increase of 4 percent in population and 11 percent in environmental impact over the no-build alternative.

- Improvements to the GDP highways with no 3-A system cause the population to be 8 percent greater than the no-build case, while expected environmental impact is up by 25 percent.

- Completion of the 3-A system and the other GDP improvements increases population by 10 percent and environmental impact by 28 percent over the no-build alternative.

Thus, it appears that in 1995, as in 1980, the 3-A system does not have a major environmental impact. It is also clear that the GDP improvements are the major source of environmental impact. This appears to be associated with the tendency of the GDP suburban highways to encourage population to be distributed over a wider range within the Baltimore region.

Further study is indicated to determine guidelines for control of regional environmental impacts caused by population distribution due to the transportation system. In particular, the GDP improvements should be examined to isolate those aspects which lead to adverse environmental impacts so that negative environmental effects of regional growth and development can be minimized.

III. INTRODUCTION

This memorandum assesses, on a regional basis, the impacts on environmentally sensitive areas resulting from the various transportation alternatives presented in Chapter I.

Transportation systems have both direct and indirect impact on environmentally sensitive areas. The direct impacts result from displacements or intrusions associated with the construction and operation of the transportation facility. These direct impacts are largely site-specific and are not specifically considered here for reasons given below.

The emphasis in this memorandum is on the more diffuse, indirect effects, which are of regional rather than of primarily local significance. These secondary effects result from new concentrations of population and economic activity resulting from transportation development in areas with varying degrees of environmental sensitivity. The basic area unit employed in the analysis is the Regional Planning District (RPD); there are 94 RPDs in the Baltimore study area. The study assesses the impacts associated with the several transportation alternatives on three categories of resources in these districts (geological-physical, biological, and water quality), in terms of an index reflecting their basic sensitivity and changes in population density. The results are presented in summary tabular form and in regional maps showing impacts by district to illustrate the regional implications of planned and projected transportation developments.

EXCLUSIONS

As noted above, direct, site-specific impacts of the several transportation alternatives are not considered in this study. The required regional emphasis, the fact that such impacts have been or will be considered in great depth in Environmental Impact Statements (102s) and 4(f) Statements, the fact that several impacts (air and noise, for example) are considered in other memoranda, and limitations of time and resources all precluded inclusion of site-specific impacts in the analysis reported in this memorandum.

HISTORIC AND CULTURAL

The cultural, historic, and archaeological sites of the Baltimore region have been identified on maps prepared by the Maryland Department of State Planning, the Baltimore Regional Planning Council, and the Maryland Historic Trust.

Within the Baltimore region, there are hundreds of designated sites. The most important of these, about two dozen sites primarily in Baltimore City and around Annapolis, are included in the National Register. Other important sites, significant within the state context, are included in the Maryland Register.

The impacts to historic sites fall into two categories. First, the loss of a site through direct displacement or destruction and second, the loss of context into which the site was set. On a local level, both of these impacts can be evaluated and dealt with in terms of specific sites; however, on the regional level, even with the population projections for the various districts, it is not possible to predict development patterns in a way which allows for a meaningful evaluation of consequences to local historic sites.

National registration is designed to prevent unreasonable destruction of sites from projects supported by Federal funds. Maryland laws and regulations also afford a significant degree of protection. Public ownership is, of course, a major bar to destruction or degradation of historic sites. In the case of privately owned sites, survival may depend largely on the interest and sensitivity of the owner. Since, in general, control over impacts on historic sites is exercised on a site-by-site basis, local interest must be generated in all areas if historic sites are to be preserved.

Direct displacement of historic sites or their contextual degradation as a product of 3-A system development has been identified in the various Environmental Impact Statements and 4(f) Statements written for the various transportation segments. Design changes are still occurring in the 3-A system to minimize historic site impacts, and therefore a summary of these impacts is not included.

OPEN SPACE

Planned open space is the result of active measures to preserve natural areas for recreation and enjoyment. The study area planned open space, which is evenly distributed throughout the region, can be divided into two classifications.

One type of land planned as open space is biologically and geologically sensitive; the open space plan protects the uniqueness of these areas which include stream valleys, wetlands, water recharge areas, unusual landforms (waterfalls, scenic ridges), and unique forests.

The other land planned as open space links the biologically and geologically sensitive areas, producing a network of trails. This "linking" open space provides the additional acreage necessary to provide sufficient open space for the population demands. Its indicated location is not intrinsically more suitable than surrounding land and possibly could be shifted somewhat, subject to limitations based on locations tied to physical features. (A very significant proportion of the valuable areas preserved in open space lies within the stream valleys which are abundant within the region.) Thus, while there is some flexibility in location of linking space, it must ultimately be included in any development of open space, and the chosen location must be consistent with the initial goals of the open space plan.

Open space has not been included as a separate parameter for this study. Because open space is so evenly distributed, the potential for open space impact is relatively uniform. The location of the "linking" open space is not strictly rigid, no specific directives can be established protecting one area over another. The geologically and biologically sensitive areas have been considered in evaluating resource sensitivity of Regional Planning Districts in this report. In this sense, the important concept of open space has been recognized indirectly.

AIR POLLUTION IMPACTS

By and large, air pollution, such as carbon monoxide and hydrocarbons, from both industrial and transportation sources tends to be site-specific rather than regional in nature. Photochemical oxidants, however, tend to be a regional problem caused by the interaction of sunlight with hydrocarbons and oxides of nitrogen. National efforts to control air pollution should result in general improvement in the Baltimore region as elsewhere. Projected trends in automobile exhaust emissions for the Baltimore planning region indicate considerable lower levels of carbon monoxide, hydrocarbons, suspended particulates, and nitrogen oxides by 1980 and 1995. This subject is covered in depth in Technical Memorandum No. 3, "Air Quality Analysis."

NOISE POLLUTION IMPACTS

Noise has a receptor-oriented impact which has little overall effect on regional environmentally sensitive areas. It may have a very great impact on selected sensitive wildlife species or on local human populations. The impacts are very much site-specific and related to specific development factors. Therefore, they cannot be dealt with to any measurable degree in this impact analysis. The specifics of noise pollution impacts are discussed in Technical Memorandum No. 5, "Noise Analysis."

WATER RESOURCE AND SOLID WASTE IMPACTS ON WATER QUALITY

The impacts of transportation development on water resources within the
Baltimore region are principally of two types: the addition of pollutants
to the waterways and the decrease of the water retention capacity of the
watersheds to the point that flooding occurs. The latter aspect seems to
be the most critical within the time-frame being considered in this study.

Technical Memorandum 4, "Water Resources and Solid Waste Analysis,"
indicates there will be potential flooding problems in the river basins of
the Jones Falls, Middle River, Patuxent, and Lower Patapsco because of
development in the upper watershed areas.

Similar problems are also projected in the Gwynns Falls, Magothy, and Severn
Basins due to development caused by transportation. Land use controls
are needed to alleviate this potential flooding problem. Water quality degradation
due to urban and highway runoff will occur to varying degrees throughout
the region but may be of significant proportions in the areas of the Magothy,
Severn, and South River Basins. It is not expected that sewage or solid
waste will have a significant impact on environmentally sensitive areas because
of the transportation alternatives since they will be subject to both air and
water pollution control laws which are becoming more stringent. The areas
indicated in Technical Memorandum 4 as the most sensitive in terms of impact
were generally assigned high or extreme sensitivity indices in this analysis.
There has been no reevaluation of these sensitivity ratings since the areas
are substantially identified under the criteria discussed below.

METHOD

Since the objective of this analysis was to establish the broad regional ramifica-
tions of the various transportation alternatives, a macroscale analysis technique
was employed. The basic geographic unit employed for analytical purposes
was the Regional Planning District. There are 94 RPDs, ranging in size
from 910 acres for RPD 118 in Baltimore City to 68,544 acres for RPD 405
in rural Carroll County. The average RPD has an area of 15,330 acres.
The total area involved is on the order of 1.5 million acres, or 2,225 square
miles. Given the size of the study area and of the RPDs, a macroscale analysis
provided the best means for consideration of broad constraints, irrespective
of minor local deviations, in dealing with gross regional changes.

The steps involved were an inventory of environmentally sensitive areas;
identification of non-homogeneously distributed environmentally sensitive
areas; assessment of resource sensitivity levels by resource type; assess-

ment of RPD sensitivity by resource; assessment of total RPD sensitivity; projection of population impacts by RPD for the alternative transportation systems; and assessment of impact on RPDs as a result of their combined environmental sensitivity and susceptibility to change in population density. The end result was a series of projected regional environmental impacts associated with each of the transportation-land use alternatives studied.

Inventory of Environmentally Sensitive Areas

Environmentally sensitive areas are those areas in which the various elements of a natural system are in a delicate balance, a balance which may be functionally altered or contaminated as a result of cultural activities occurring on or in close proximity to them.

Documents and maps of the resources in the region were reviewed to determine the existence and location of sensitive areas. The general framework into which each type of sensitive area is set was also identified. The inventory was accomplished principally through the collection of available maps from the Baltimore Regional Planning Council, Maryland Department of State Planning, and the Maryland Department of Natural Resources. This information was supplemented with material from publications dealing with the Baltimore regional resources and through interviews with area experts.

As a result of the inventory process, a large number of small areas characterized by unique or unusual natural features were identified. This led to an early difficulty in that a great deal of data on environmentally sensitive areas was in hand, but there was little information on which the expected impacts of the various alternatives could be compared or contrasted. This led to the necessity of sorting out those sensitive areas which were non-homogeneous in distribution from those more or less randomly scattered across the region.

Identification of Environmentally Sensitive Areas of Non-Homogeneous Distribution

Uniformly distributed environmentally sensitive areas offer little help in evaluating transportation plans; if not impacted in one area, they will be in another. It was, therefore, considered necessary to factor them out and primarily to consider those sensitive resources whose distribution within the region was non-homogeneous. These were mapped to show the areas of greater sensitivity.   However, as a result of this level of analysis, there are many very sensitive areas which are not reflected on assessment maps but which are extremely sensitive to encroachment and should be protected.

Assessment of Resource Sensitivity Levels by Resource Type

Sensitivity levels were assigned for the resource factors (geological-physical, biological, and water quality) involved in the inventory. Sensitivity values ranged from zero to three. The assigned value refers to the likelihood of damage to the resource element if it or its surroundings were subjected to increased concentrations of people. Thus, assigned levels represent only a ranking of sensitivity among elements of like kind and do not show relationships between resource elements on a comparative scale.

Sensitivity Level 3 was used to indicate resource areas where population concentrations might seriously degrade or even destroy an extremely valuable resource or combination of resources. Levels 2 and 1 were assigned to areas also sensitive to population concentrations but which do not include resources of the same number, kind, or quality as those found in areas designated as Level 3. Zero denoted either the absence of the resource being mapped or, in the case of water quality, areas where degradation had occurred to the point where development is likely to have little or no further impact. (It is recognized that removal of the degrading factors in such areas might make it possible in many cases to restore the affected resource to a higher level. However, such possibilities did not lie within the scope of this assignment.)

Assessment of RPD Sensitivity by Resource

The next step involved the derivation of a generalized sensitivity value for each resource category within each RPD. This was accomplished by assessing the collective sum of sensitive areas (of a given type) falling within the district. The relative abundance of each sensitivity level was evaluated in relation to the area of the district. The district was then assigned a resource sensitivity index value which characterized its relative sensitivity. In situations where there was a question as to which of two levels of sensitivity was to be assigned arose, the higher or more conservative rating was chosen. Regional maps displaying sensitivity indices assigned to each RPD for each of the three resources under consideration were prepared. A combined map was then prepared to show total resource sensitivity for each district.

Projected Population and Transportation Alternative Impacts

Anticipated impacts associated with population changes were developed. These, which ranged from a level of zero to three, were assigned on the basis of criteria, depending upon baseline (1970 data) population density

and anticipated change associated with each transportation alternative.
For each district, the population index value was multiplied by the sensitivity
index value to yield an impact index value reflecting both distributional
variation in impacts among alternatives and gross changes in population.
The net result is a series of impact maps, one for each option, illustrating
the expected mangitude of impacts. Examination of the maps and tables reflecting
the basic data on both a regional and district-by-district basis permits evaluation
of the differential impacts along alternatives.

IV. DETERMINATION OF GEOLOGICAL-PHYSICAL SENSITIVITY

INVENTORY

General Geology

The Baltimore region lies in parts of two physiographic provinces, two-thirds within the Piedmont and one-third in the Coastal Plain; the two are separated by the Fall Line. To the northwest are igneous and metamorphic crystalline rocks and to the southeast are Coastal Plain unconsolidated gravel, sand, and clay. The Piedmont rocks were originally sedimentary, formed beneath the sea and subsequently uplifted and enfolded during periods of mountain building which subjected them to intense heat and pressure, metamorphosing them into crystalline rocks. During metamorphism igneous rocks were also formed and emplaced among the metamorphic rocks. Numerous periods of erosion have since exposed these rocks at the surface, and the present topography is a result of erosion controlled by the northeast-southwest trending structure and relative erosion resistance of the rock.

The Piedmont can be divided by rock type into three belts: Eastern Piedmont Plutonic rocks (igneous rocks formed deep within the earth), Eastern Piedmont metamorphic rocks (metamorphosed sedimentary rocks), and Western Piedmont metamorphic rocks. The Eastern Piedmont plutonic rocks consist of granitic and gabbroic rocks outcropping predominantly to the northeast and the southwest of Baltimore. West of these rocks are gneiss, schist, marble, and metaconglomerate of the Eastern Piedmont northeast-southwest trending metamorphic belt. Further west are gneiss, schist, slate, limestone, marble, quartzite, and metabasalt of the Western Piedmont metamorphic belt.

The Coastal Plain sediments consist of unconsolidated gravel, sand, and clay deposits of numerous formations which dip slightly to the southeast. Many of these formations are important aquifers.

Groundwater Geology

The main source of water supply in the Baltimore region is surface water from reservoirs at the Loch Raven Dam, Prettyboy Dam, Liberty Dam, and from pipelines to the Susquehanna River. As surface water supplies become depleted, groundwater will become a more important source of water supply, especially on the Eastern Shore and southern Anne Arundel County. Presently, groundwater in the immediate Baltimore area is not fully utilized

because of isolated water quality problems and the cost of well drilling and usage.

In general, groundwater in the Coastal Plain province is readily available for public industrial, commercial, and domestic water needs. The groundwater is located in the unconsolidated sands and gravels that make up large portions of the Raritan, Patapsco, Magothy, and Patuxent formations which outcrop to the southeast of the Fall Line. Wells drilled into these formations are supplying generally high yields (100-2,160 gallons per minute) of good quality water.

In the Piedmont physiographic province, lower Paleozoic and Precambrian rock units contain important groundwater supplies which occur mainly in porous, permeable, weathered overburden throughout the region. The Grove Limestone, Frederick Limestone, Wakefield Marble, and Cockeysville Marble are the most productive aquifers (yields of 1-580 gallons per minute) of good quality water within the Piedmont province.

GEOLOGICAL-PHYSICAL ENVIRONMENTALLY SENSITIVE AREAS

The Baltimore region contains a wide variety of hydrologic, geologic, and soils parameters which are important parts of the ecosystem and which directly influence the regional environmental sensitivity. These parameters directly determine the ability of land to support humans and associated development. The parameters include slope, permeability, soil texture, frequency of flooding, depth to bedrock, depth to seasonal water table, type of parent material (bedrock), presence and depth to impermeable pans, pH, and erodability.

Ten land use suitability associations were developed by Collin (7) by combination of the above constraints with Soil Conservation Service soil series constraints information. The ten associations reflect a progression from areas presenting a minimum of problems for intensive development to areas on which no development should be allowed. In each of the ten associations, all of the parameters of slope, permeability, etc., were clustered into groups of parameters which are naturally found throughout the region. For the purpose of this study, the ten associations were arranged according to degree of land-use problems into five distinct land-use associations and mapped at a scale of one inch to the mile. (This map is not included in this report).

Unfortunately, the map shows that the five associations are homogeneously dispersed throughout the region and do not break easily into natural or artificial groups. For example, associations depicting the location of

flood-prone areas, steep or unstable slope areas, and generally developable areas occur nearly randomly throughout the region. Consequently, the five land-suitability associations offer limited help for broad regional planning, but lend themselves to the site identification of specific land-use problems. Similarly, mineralogic sites of both economic and academic importance are also evenly distributed throughout the region and are not useful in the overall regional planning scheme. Areas of significant seismic (earthquake) activity are not present in the region.

Distribution of Geological-Physical Sensitive Areas

Despite the fact that land-use associations are generally rather uniformly distributed throughout the Baltimore region, nonrandom geological-physical features of broad environmental and practical significance were found to occur over well-defined areas. To identify environmentally sensitive areas, it was necessary first to identify geological and hydrological environmental features critical to general land and resource use. The features chosen are relatively widespread in distribution; they include parameters representing potentially serious problems should development take place where they occur. Maps prepared by the Baltimore Regional Planning Council show areal distribution of these selected geological-physical features:

- Natural sand and gravel resources

- Potential crushed stone resources

- Aquifer outcrops for groundwater resources

- Flood and impermeable soils

- Existing and Potential areas of septic tank failure

The first three consist of resources which could be directly affected adversely by development; the last two represent existing conditions which should act as a bar to or restraint on development. In most of the greater Baltimore region, one or more of these five geological-physical features is present. Areas possessing the greatest numbers of these critical geological-physical features are considered to be most environmentally sensitive.

GEOLOGICAL-PHYSICAL RESOURCE SENSITIVITY LEVELS

In creating the hydrologic, geologic and soils environmental sensitivity areas map, a series of individual resource overlay maps were used. These plotted aquifer outcrops for groundwater resources, potential crushed rock

IV-3

resources, natural sand and gravel resources, existing and future areas of septic tank failure, and impermeable soils. All plotted areas were given a value of one with the exception of aquifer outcrops of groundwater resources which were given a value of two. This was done because groundwater quality and quantity are more directly affected by land use development where aquifer outcrops appear, and groundwater resources are used extensively for public, industrial, commercial, and domestic water needs. Water is, of course, a vital part of the ecosystem, and groundwater is intrinsically tied to surface water occurrences.

The five overlays were colored and combined, allowing the individual values to be added. Areas of equal total value were delineated and ranged from zero to six. Four sensitivity levels were achieved: "low sensitivity" for those areas containing none of the non-homogeneously distributed resources, "moderate sensitivity" in areas having a physical resources score of one, "high sensitivity" in areas with a score of two to three, and "extreme sensitivity" in areas where the combined score was from four to six. Moderate, high, and extreme sensitivity levels were assigned numerical index values of one, two, or three, respectively; low sensitivity levels were rated zero. These values were used in the overall RPD sensitivity evaluation.

Geological-Physical Sensitivity by RPD

The assignment of a sensitivity value for each RPD was accomplished by appraising the areal extent of the extreme, high, moderate, and low sensitivity levels indicated above. The values representing the sensitivity levels in each district are in the Appendix and are graphically represented on the map in Figure IV-1. The map indicates the areas of greatest concern are the Coastal Plain and certain Piedmont sections of the region. The Fall Line area boundary between these two zones constitutes the most sensitive region as evidenced by the distribution of extreme sensitivity districts.

SENSITIVITY BY RPD

EXTREME
SENSITIVITY

HIGH
SENSITIVITY

MODERATE
SENSITIVITY

LOW
SENSITIVITY

BALTIMORE
REGIONAL
ENVIRONMENTAL
IMPACT
STUDY
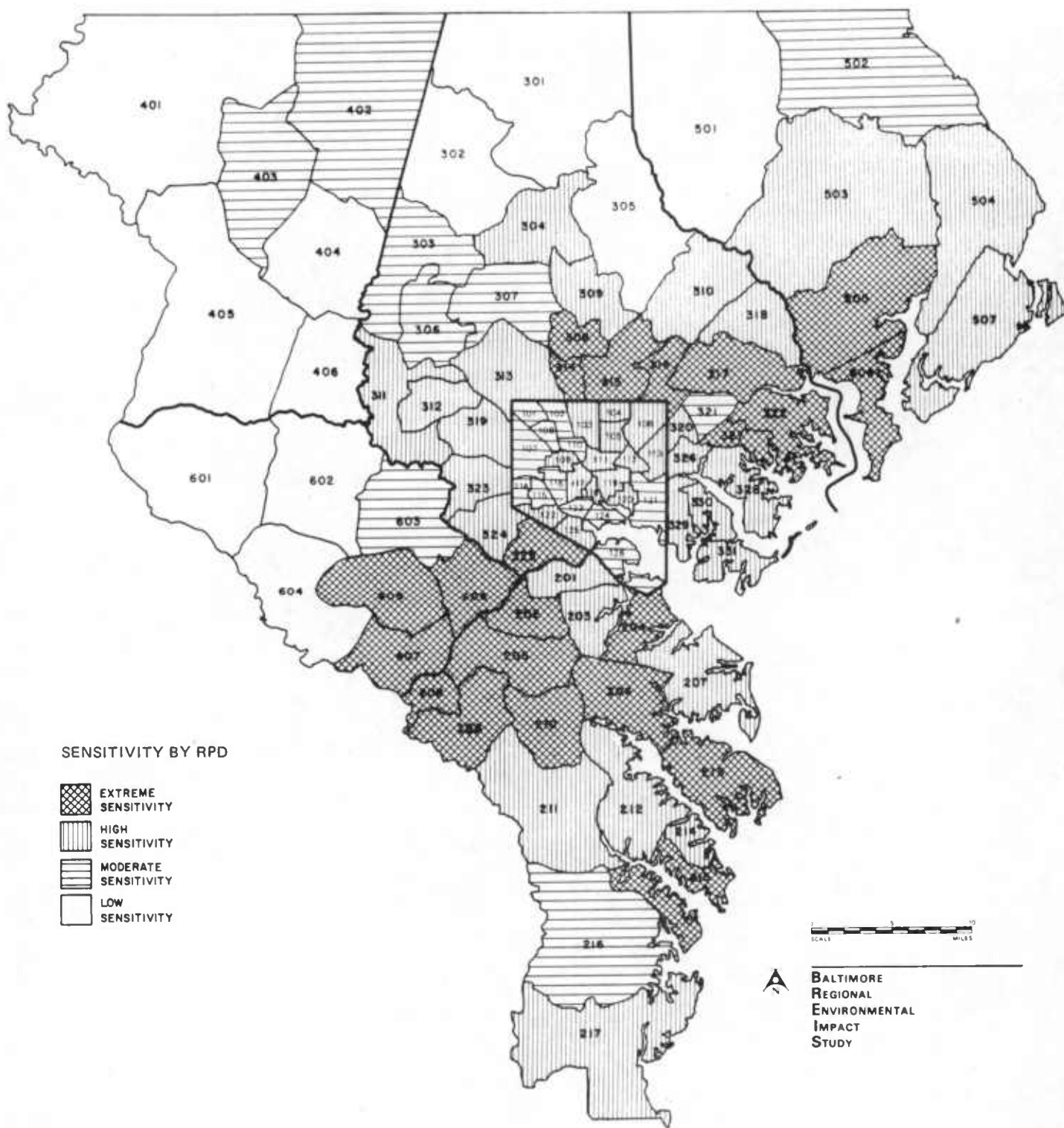
FIGURE IV-1
GEOLOGICAL—PHYSICAL SENSITIVITY MAP

V. DETERMINATION OF BIOLOGICAL SENSITIVITY

INVENTORY

Vegetation

Within the five counties that make up the planning region, lumbering constitutes a significant economic activity. The annual harvest is in excess of ten million board feet, mainly in Harford, Baltimore, and Anne Arundel Counties. Tulip Poplar is the most valuable and most harvested species; however, oak and hickory also contribute large volumes of lumber. Other hardwoods utilized by the lumber industry are sweetgum and soft maples. Various species of pine, particularly Virginia Pine, constitute a significant source of pulpwood. The most productive stands of Tulip Poplar occur in upland Piedmont portions of Baltimore and Anne Arundel Counties, while the largest volumes of oak and hickory are in Carroll, Baltimore, and Harford Counties. Anne Arundel County contains the largest and most productive stands of Virginia Pine.

There are discrete locations throughout the planning region which harbor rare or unique flora that are particularly sensitive elements in the environment.

Terrestrial Wildlife

Habitats favorable for game birds and mammals occur throughout the five-county planning region. Quail and Cottontail Rabbits are found in widely distributed areas where suitable habitats exist. The most productive habitats for Gray Squirrels are the oak-hickory forests, wherever they occur. The best habitats for both Gray Squirrels and doves exist in Anne Arundel County. Grain farms constitute particularly favorable habitats for Mourning Doves. Gray Squirrels tend to decrease in numbers towards the northern and eastern portions of the region while deer and pheasants, on the other hand, increase in numbers in that direction. The Aberdeen Proving Ground in Harford County contains a diversity of productive habitats for various mammals and is the only location in the region where wild turkeys are found. In addition to wildlife of interest to sportsmen, there are other species which are very important because they are rare and endangered. These species and their habitats are highly vulnerable to impacts resulting from development and must, therefore, receive considerable attention in the planning of regional growth.

Wetlands

Marshes, swamps, surface waters, and other wetland categories that are
smaller than five acres follow the extensive river system of the region.
Accordingly, they are generally randomly distributed throughout the five
counties in a manner which does not provide a realistic basis for decision-
making. However, the wetland areas of five acres or greater are considered
to be of sufficient size and are distributed in such a pattern that they
can be compared and rated on a sensitivity scale and treated accordingly.

Wetlands Wildlife

The major game species of waterfowl is the Wood Duck, although the Mallard
and Black Duck are also important. In general, Wood Duck habitats are most
abundant, and populations of this species highest, in those sections of the
region with the greatest concentration of streams. Howard County, for
example, contains many streams with bordering woodlands and shrub growth
that Wood Ducks favor as habitat. Other prime waterfowl habitats occur
within all of the watersheds northwest of Washington, D.C., that empty into
the Potomac. The eastern shore of Chesapeake Bay serves as an important
wintering ground for Canada Geese and diving ducks such as Canvasback,
Scaup, Ruddy Duck, and Old Squaw. Large flocks of these species gather in
waters near the coastline of Harford, Baltimore, and Anne Arundel Counties.
Certain wetlands provide habitat for rare and endangered species of wild-
life. Wetland breeding sites of rare and endangered species should be
regarded as highly sensitive areas which may be subject to a variety of
adverse impacts from development.

Freshwater Fisheries

There are many surface waters throughout the region that provide suitable
habitats for native populations of cold water sport fish species or which are
artificially stocked to support put-and-take fishing. To a large extent,
these waters are randomly distributed; hence, there is no clear-cut basis
of comparison for sensitivity rating. However, the waters that are the
most heavily stocked and intensively fished do occur in a pattern which
allows them to be precisely located and treated as sensitive features of
the environment that are vulnerable to impact.

For the most part, the waters containing suitable habitats for species of
warmwater fish are also distributed randomly in a manner which does not
permit comparative rating on a sensitivity scale. Management of warmwater
fisheries throughout the region is limited to public water supply reser-
voirs. In Baltimore County, Liberty, Prettyboy, and Loch Raven Reservoirs

are stocked with Largemouth Bass, Smallmouth Bass, Black Crappie, Walleye, and Northern Pike. The only managed water in Carroll County is a portion of Liberty Reservoir. In Howard County, Rocky Gorge and Triadelphia Reservoirs receive stockings of Black Crappie, Largemouth Bass, and Smallmouth Bass. Conowingo Reservoir in Harford County is managed for Walleyes, Largemouth and Smallmouth Bass. Finally, in Anne Arundel County, Lake Waterford is stocked with Largemouth and Smallmouth Bass. Because of the high value assigned by society to public water supplies, it is unlikely that the fisheries resources in them will be adversely impacted by regional development.

BIOLOGICAL ENVIRONMENTALLY SENSITIVE AREAS

Vegetation

There are areas of particular botanical value or sensitivity because of rare or unique plant species and vegetative groupings. One such location is the Susquehanna Gorge where unusual species of plants have been identified. Another is the Soldier's Delight Park in Baltimore County which contains an unusual flora; certain species of these are considered rare and others, such as Post Oak and Blackjack Oak, are of special significance because they approach their northern limits of distribution.

Throughout portions of Howard, Baltimore, and Harford Counties there occurs a discontinuous, northeast-southwest trending band of serpentine bedrock. The toxic properties of the serpentine drastically limit the vegetative cover, reducing the number of plant species which can grow in these areas. Some of the plants are so adapted to these serpentine-generated soils that they grow nowhere else. The serpentine-derived soils and associated plant covers constitute a delicate system, and the ground surface frequently remains exposed for a long period of time after removal of the plant cover because of slow rates of revegetation.

Rocky Gorge, along the Patuxent River in Howard County, and the Glen Artney area within Patapsco State Park are other locations of particular value as locations for rare and unusual flora. In Rocky Gorge, a Magnolia normally of more southerly distribution (Magnolia tripetala) and several rare species of fern have been found. In Glen Artney, Sheep Laurel, a shrub usually of more northerly distribution, and Climbing Fern are two of the rare species that have been identified.

Terrestrial Wildlife

There are several species of terrestrial wildlife whose status as breeding species in Maryland is endangered or which are considered rare in the

State. The Upland Plover, which favors large upland hayfields, is repre-
sented by fewer than 20 pairs in Baltimore County. The regional population
of Long-Eared Owls consists of fewer than 100 pairs; their range is gen-
erally restricted to the pine woods of Baltimore County. Within Carroll and
Howard Counties there are fewer than 30 pairs of Dickcissels, a bird of
clover and alfalfa fields. In Anne Arundel County, the Lark Sparrow, found
generally on abandoned fields with poor soil, is represented by fewer than
5 pairs.

The presence of a rare species of snake, the Scarlet Snake, has been
recorded in Anne Arundel County. The habitat for this snake is being
destroyed by development of the Coastal Plain.

Wetlands

The largest percentage of wetland areas of 5 acres or greater size is
found in Harford, Anne Arundel, and Baltimore Counties. In Harford County,
the wetlands occur primarily along the shoreline of upper Chesapeake Bay. A
large part of the 9,300 acres of County wetlands and shore area is in
Federal ownership. The reverse is true in Anne Arundel County, where three
quarters of the 7,160 acres of wetlands are privately owned. Most of the
Federally-owned wetlands are located within the boundaries of Fort George
Meade along the Patuxent and Little Patuxent Rivers; the remaining wetland
areas are located principally along the shoreline of the Gunpowder, Middle,
and Back Rivers, and other estuarine areas fronting on the Chesapeake Bay.
Approximately two thirds of these wetlands are in Federal ownership, and
the remainder is privately owned. While there are few wetland areas of 5
acres or greater in Carroll and Howard Counties, woodland streams, very
valuable as wildlife habitat, are numerous in both counties.

Along the shoreline of Chesapeake Bay in Harford, Baltimore, and Anne
Arundel Counties there are numerous embayments, estuaries, salt marshes,
and tidal flats. These areas are valuable for their production of nutri-
ents and detritus and as habitat for shellfish, waterfowl, marsh birds, and
several species of endangered wildlife, including the Osprey and Bald
Eagle.

Wetlands Wildlife

The best habitats for Wood Ducks, Blacks, and Mallards are along the Gun-
powder, Susquehanna, Patuxent, and Upper Patapsco Rivers. These areas are
vulnerable to developmental impacts through direct destruction of habitat.

Among the species of wetland wildlife whose breeding status is threatened
in the state (Table V-1) are the Pied-Billed Grebe, Yellow-Crowned Night

Table V-1

RARE OR ENDANGERED WILDLIFE

Baltimore	Harford	Howard	Carroll	Anne Arundel
Pied-Billed Grebe				
Yellow or Night Heron				
Cooper's Hawk*	Cooper's Hawk*	Cooper's Hawk*	Cooper's Hawk*	Cooper's Hawk*
Southern Bald Eagle	Southern Bald Eagle			Southern Bald Eagle
Osprey*	Osprey*			Osprey*
Sora Rail				
Upland Plover				
Least Tern*	Least Tern*			Least Tern*
Long-Eared Owl				
		Dickcissel	Dickcissel	Lark Sparrow
				Scarlet Snake
				Red-Bellied Water Snake
Bog Turtle	Bog Turtle		Bog Turtle	

*Nationally Endangered

V-5

Heron, and Sora Rail. There are fewer than 30 breeding pairs of each
species, all occurring primarily in Baltimore County. Freshwater ponds
with emergent vegetation constitute the typical habitat of the Grebe while
the Sora occurs in both brackish and fresh wetlands. Pairs of the Yellow-
Crowned Night Heron are most likely to be found along stream valleys and in
floodplain forests. It has been estimated that both east and west shores
of Chesapeake Bay accommodate upwards of 75 percent of the national
breeding population of Ospreys.

Two species of reptiles considered rare by the Maryland Herpetological
Society are the Bog Turtle and the Red-Bellied Water Snake. A single
specimen of the latter species was taken from the head of the Severn River
in Anne Arundel County, and it is not known whether there is a sufficient
number of individuals for a viable breeding population. Isolated popu-
lations of the Bog Turtle are know to exist in northeast Carroll County,
northern Baltimore County, and parts of Harford County.

Freshwater Fisheries

The five counties that comprise the planning region support a viable cold
water put-and-take fishery. (Water stocked to be fished out immediately).
In addition, the headwaters of some of the streams provide productive
natural trout habitats. Important populations of Smallmouth Bass are also
found in Deer Creek and the Gunpowder River in Harford and Baltimore Coun-
ties. Put-and-take fishery stream locations and numbers of fish stocked
are related to the quality and abundance of habitat and capability of the
waters to sustain populations of the stocked fish. Species of fish stocked
include Rainbow, Brook, and Brown Trout. In Baltimore County, the major
trout waters are Gunpowder River and the Jones and Little Falls Watersheds.
Deer Creek in Harford County and the Patuxent River in Howard County are
stocked waters. The Beaver Run, Morgan Run, and Piney Run in Carroll County
are stocked, as is Severn Run in Anne Arundel County. All stocked waters
receive 5,000-10,000 trout, with Rainbows provided in a higher proportion
than Brook or Brown Trout. The Gunpowder River and Little Falls Watershed
receive stockings of as many as 20,000 fish.

The only species of fish on the list of endangered species is the Maryland
Darter, whose only known habitat is near Havre de Grace in Harford County.

BIOLOGICAL RESOURCE SENSITIVITY LEVELS

Natural Areas and Wetlands Larger than 5 Acres and Estuaries

These two natural resource categories have been combined and accorded the
highest sensitivity and value rating on a scale of three. The criteria for

this assignment are based on several practical considerations. Within this combined category, there are a number of interests served and functions performed. These include water storage, wildlife habitat, public recreation, and one or more of the other four single categories. The resources of the combined category are very easily destroyed or despoiled because of their fragility, erodability, or uniqueness. Certain natural areas and wetlands have been accorded the status of parks protected by State or Federal laws. This, however, does not eliminate their susceptibility to impacts resulting from development on adjacent watersheds or land parcels or from excessive pedestrian encroachment. Estuaries along the shoreline of the Chesapeake Bay are included in the extremely sensitive category because of their high productivity and value as wildlife and shellfish habitat.

Unusual and Sensitive Flora; Rare or Endangered Wildlife

This combined category has been accorded an intermediate rating of value and sensitivity. The functions performed in the ecosystem by species of rare plants and wildlife are few compared to those of the natural areas and wetlands discussed above. Populations of rare species may be difficult to locate and, in the case of migratory wildlife species, may change from season to season. Where observational data is lacking, it may be difficult to assign a sensitivity and value rating. On the other hand, the preservation of species threatened by statewide extinction is an important consideration.

Though all rare and endangered species are considered sensitive, relatively higher sensitivity ratios must be assigned to those with discrete and identifiable habitats since these can be protected. In addition, nationally endangered species are rated as more highly sensitive than those species with restricted ranges within the State of Maryland, but with a greater distribution elsewhere.

Highly Productive Waterfowl Habitat and Trout Water

These areas have been assigned a sensitivity value of one because of their role in maintaining valuable wildlife resources. The wetland areas indicated on the sensitivity map are those of regional significance. These areas should not be considered low in sensitivity because of their rating of one but should be considered in perspective as being slightly less sensitive than other regional biological resources. Locational factors do tend to make them development-prone.

With careful design and planning, development need not be incompatible with production of waterfowl and trout. Suitable habitats for both waterfowl

and fish can be created through proper manipulation of the environment. Waters not of sufficient quality to support native populations of fish or large breeding populations of waterfowl, but which are stocked regularly, are less sensitive than fish and waterfowl habitats with a high rate of natural productivity. While water quality can be upgraded to permit re-establishment of natural productivity, the trend in an area exposed to development is apt to run the other way. Therefore, impacts to highly productive waterfowl and trout habitats must be viewed as a substantial threat to regional resources and must be carefully evaluated where development has a high potential for destroying that resource.

BIOLOGICAL SENSITIVITY BY RPD

The assignment of a sensitivity index value for each district involved not only the areal extent of the sensitive areas within each but also their distribution. The more widely distributed the areas, the greater the chance of impact from population. Another less tangible factor used in the evaluation of the degree of sensitivity of each district was the number of disjunct populations of rare or endangered wildlife species residing in the area. In areas where greater numbers of rare and endangered species are most likely to be, the districts were conservatively rated to the next higher sensitivity value. Estuaries were also given similar treatment in regard to the assignment of index values to those districts with substantial estuaries present.

The index value placed on each RPD necessarily represents a somewhat subjective appraisal of the total susceptibility and sensitivity of the biological resource in that area. The assigned sensitivity indices are presented in the Appendix, Table A-1, and are displayed on the map in Figure V-1.

SENSITIVITY BY RPD

▧ EXTREME
    SENSITIVITY

▨ HIGH
    SENSITIVITY

▤ MODERATE
    SENSITIVITY

☐ LOW
    SENSITIVITY

BALTIMORE
REGIONAL
ENVIRONMENTAL
IMPACT
STUDY
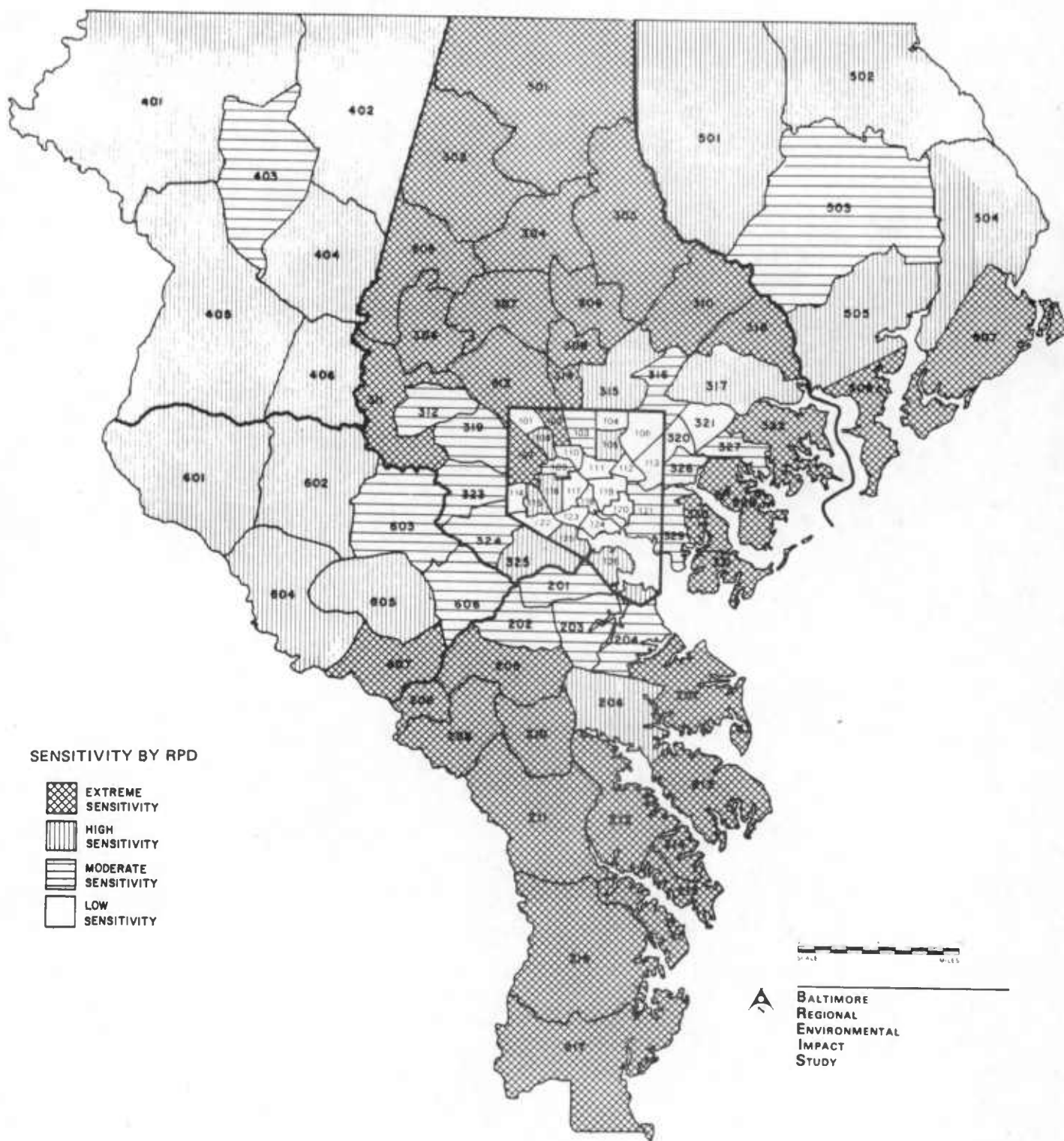
FIGURE V-1
BIOLOGICAL SENSITIVITY MAP

VI. DETERMINATION OF WATER RESOURCES SENSITIVITY

INVENTORY

General water quality criteria and specific water quality standards for the streams and rivers within the study area have been determined by the Water Resources Commission and the Department of Water Resources, State of Maryland. This information has been examined and related to the proposed transportation alternatives for the Baltimore region.

Overall water use in the Baltimore region falls into six categories:

1. Shellfish harvesting

2. Public or municipal water supply

3. Water contact recreation

4. Propagation of fish, other aquatic life, and wildlife

5. Agricultural water supply

6. Industrial water supply

Regional surface water features have been mapped and classified according to the above uses. For the purpose of this study, the five-county Baltimore region was divided into its respective watersheds. Each watershed was then classified as to use and given a letter designation (A, B, or C) according to current state standards. The criteria depend upon usage of the waters as indicated below:

- Group A -- Waters used for 1, 2, 3, 4, 5, and 6.

- Group B -- Waters used for 2, 3, 4, 5, and 6.

- Group C -- Waters used for 3, 4, 5, and 6 above.

Thus, it is readily apparent that high water quality is associated with maintenance of shell fisheries and public drinking water.

WATER QUALITY SENSITIVITY AREAS

A discussion of regional water quality also appears in Technical Memorandum 4, "Water and Solid Waste Analysis." In this memorandum, overall existing water quality, by watershed, is used as a sensitivity evaluation factor.

The watersheds of the region vary in their water quality ratings. Thus, it was possible to evaluate differential impacts of varying transportation alternatives. Water quality of the region is generally excellent in the western and northwestern parts of the region. The major watersheds of the Patuxent, Patapsco, and Gunpowder Falls Rivers and Big Pipe Creek are all classified as having potable surface water.

The surface water of Anne Arundel County is of somewhat lesser importance; it is, however, of relatively high quality. These waters need to be pre- served in quality to assure a suitable aquatic environment for both fresh- water and estuarine organisms and to maintain current cultural use classifications.

WATER QUALITY SENSITIVITY LEVELS

For the purpose of this study, each watershed was assigned a sensitivity index rating according to its use. Ratings ranged from zero to three, with three indicating the highest sensitivity. Only Group B watersheds received a three rating; that is, only those watersheds containing streams used as potable water supplies were classified as most sensitive and subject to major impact from development. The presence of sensitive shellfish beds in Group A watersheds earned those of this class a two rating. The remaining watersheds (Group C) received either a zero or one rating, depending on location and the actual water uses as indicated by the Maryland criteria.

WATER SENSITIVITY BY RPD

To assess water sensitivity of the Regional Planning Districts, a map of the RPDs was placed over the regional watershed map. Each RPD was then given a sensitivity rating according to the assigned ratings and classi- fication of the underlying watersheds. Specific district-by-district assignments are listed in Appendix Table A-1 and are shown on the map in Figure VI-1.

In the larger zones along the western edge of the study area, the water- sheds were all rated three, and thus the RPDs in this area also received a three rating. In Baltimore City and some of the adjacent developed zones, the assigned sensitivity rating was zero. That is, it was judged that in such areas increased population would have little or no effect on current surface water quality. In some instances, current quality could be en- hanced by undertaking active measures to eliminate existing factors causing degradation; where such possibilities appear realistic, special attention should perhaps be devoted to limiting any further degradation. Remaining areas were given sensitivity ratings, dependent on the classification of the underlying watersheds, of two or one.

SENSITIVITY BY RPD

EXTREME
SENSITIVITY

HIGH
SENSITIVITY

MODERATE
SENSITIVITY

LOW
SENSITIVITY

BALTIMORE
REGIONAL
ENVIRONMENTAL
IMPACT
STUDY
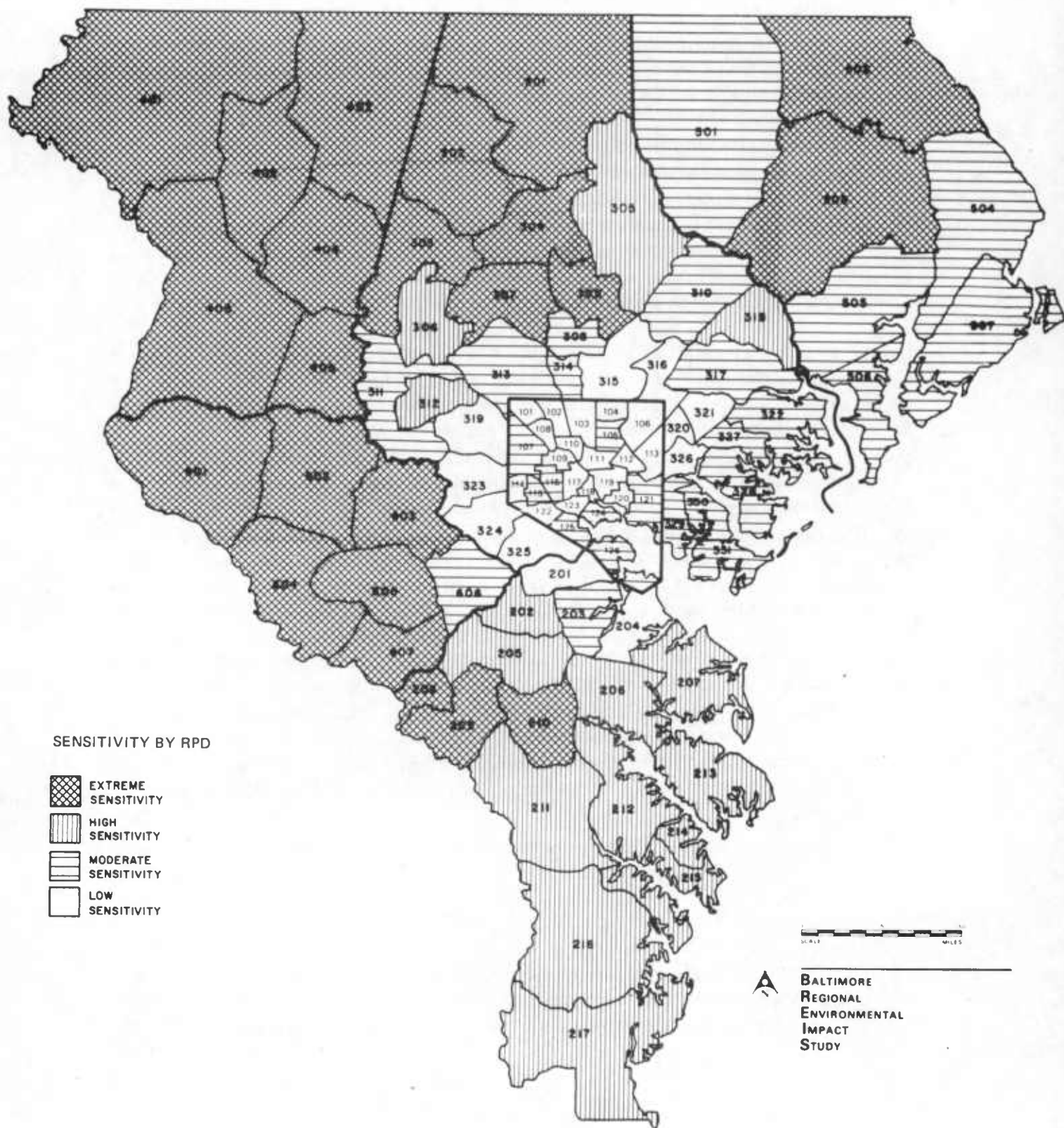
FIGURE VI-1
WATER QUALITY SENSITIVITY MAP

VI-3

A single RPD often covered more than one watershed. In such cases, the RPD received the rating which encompassed the largest area on the underlying map. Thus, if 75 percent of the underlying area had a sensitivity rating of two, and the remainder one, the rating assigned the RPD was two. If any significant portion of the underlying watershed had been assigned a three rating, the entire district also received a three rating.

As stated above, areas used as potable water supplies are rated three and considered the most susceptible to developmental impacts. Overall changes may result from construction activities and the presence of new highways, housing developments, industrial complexes, and other features associated with the future development of the general area. These activities and conditions may produce similar impacts in other watersheds, but existing conditions may be such as to minimize such impacts.

In any event, care should be taken to hold all impacts on water quality to a minimum regardless of the sensitivity rating of an area. Water quality is dependent on land use, activities, population, and use of the water itself. Protective construction techniques and control of land use should be employed appropriately to hold erosion, runoff, turbidity, and other factors adversely affecting water quality to an absolute minimum. Strict enforcement of Maryland's Erosion Control Law is essential, especially where the RPD has a water quality rating of three, if negative impacts are to be controlled . Shellfish beds (Group A watersheds) are sensitive areas and susceptible to contamination. Although such areas may take up only a small portion of a development zone, their significance must be recognized. Care should be taken in these areas to do everything possible to insure perpetuation of the species present. This requires maintenance of overall water quality. In some areas where the overall rating is one, for example, a very small proportion of the zone may merit a rating of two. In such instances, these sensitive areas should be identified and provision made for their protection. Even where the assigned sensitivity rating is zero, caution should be exercised and water quality should not be allowed to deteriorate.

VII. ASSESSMENT OF TOTAL RPD SENSITIVITY

In the assessment of combined sensitivity values for each district, the three resource sensitivity index ratings were considered to be of equal importance. The combined value was computed by summing the values for geological-physical, biological, and water quality sensitivities. The resulting sums were then reduced to new values. Eight and nine were judged to represent extreme sensitivity and were assigned a new value of three. Those having a value of six or seven were classified as highly sensitive, receiving a value of two on the new scale. Those with a total of five or less were classified as moderately sensitive; these were given a new value of one. A value of zero was assigned to certain slightly sensitive RPDs in Baltimore City where it was judged that the potential for impact was so slight as not to merit a higher classification, even though there may have been resources of some potential value located in the district. These total sensitivity values are presented in the map of Figure VII-1. Table A-1 in the Appendix presents the district-by-district index value for each resource category and the combined result on which the map is based.

SENSITIVITY BY RPD

EXTREME
SENSITIVITY

HIGH
SENSITIVITY

MODERATE
SENSITIVITY

LOW
SENSITIVITY
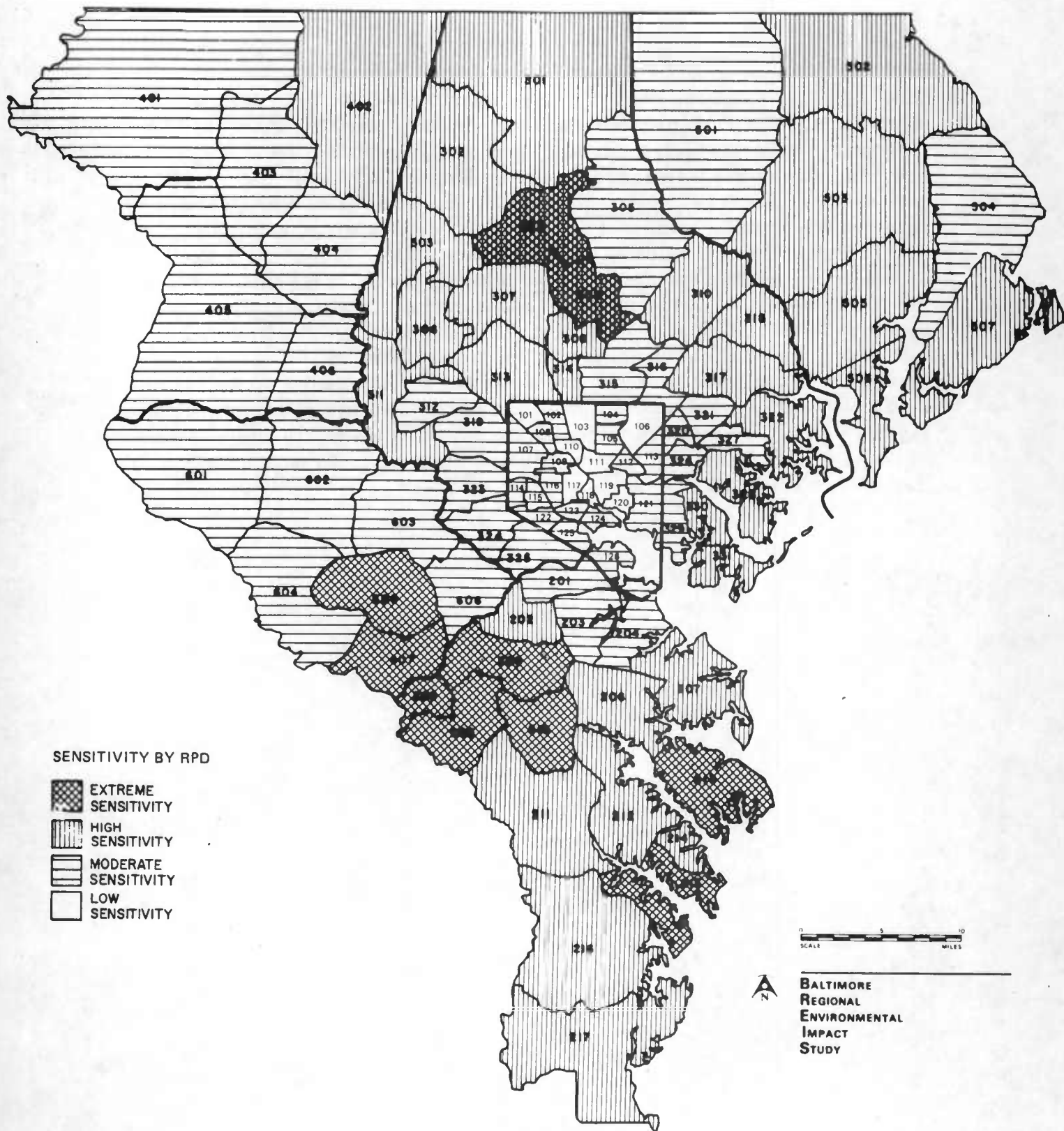
FIGURE VII-1
COMBINED SENSITIVITY MAP

BALTIMORE
REGIONAL
ENVIRONMENTAL
IMPACT
STUDY

VIII. INDEX OF POPULATION IMPACT POTENTIAL

As population density increases, environmental stress tends to increase, and environmentally sensitive areas may become degraded or destroyed. While it is assumed that the most easily developed or aesthetically desirable areas will be used first, it is impossible to predict the specific sensitive or non-sensitive areas which will be developed or impacted within a given district. It is assumed that there are no adequate controls to limit development of sensitive areas, and, thus, degradation of these areas will be a function of increasing population density associated with the various transportation and land use alternatives.

The establishment of a relative value for population change was accomplished by correlating the various existing population densities and the projected percentage changes in population. Assigned values, ranging from zero to three, are presented in Table VIII-1. The criteria for assignment of these values are discussed below.

For all initial population density levels, a decline, or an increase of no more than 5 percent, led to assignment of an impact value of zero. Little or no significant impact is to be expected as a consequence of this magnitude of change. A value of zero was also assigned in situations where district populations are in excess of 20 people per gross acre, on the general assumption that in areas with such high density levels any sensitive areas which might have had regional significance have already been degraded seriously or lost.

A value of one was assigned to districts where the negative impact potential resulting from population change was considered to be moderate. This holds for modest population increases in low density districts. An impact value of one was also assigned to all increases greater than 5 percent for districts with a density of 10-20 people per acre. There are usually few sensitive areas of regional significance left in an area which has reached this degree of development.

A high anticipated impact value of two was assigned to districts that have a current population density of 5-10 persons per acre and would expect to experience a greater than a 20 percent change in population density. Additionally, some districts with lower existing population densities received this designation based on the degree of change that would occur. Districts receiving a value of two still retain regionally significant areas which could be lost to increasing population pressure.

Table VIII-1

POPULATION IMPACT INDEX MATRIX

Percent Change Compared To Existing (1970, Alternative 1)

Population Density	(-) - +5	5-20	20-50	50-100	100-200	200+
0-1	0	0	1	1	2	3
1-2	0	1	1	2	3	3
2-5	0	1	2	3	3	3
5-10	0	1	2	2	2	2
10-20	0	1	1	1	1	1
20-55	0	0	0	0	0	0

The highest value which was assigned, a three, indicating severe potential impact, delineates a situation in which districts that contain a large portion of the most sensitive areas can be threatened by substantial development. All of these districts currently have a population density of less than 5 persons per acre. As is illustrated in Table VIII-1, the severe threat occurs when this relatively low initial population density correlates with a high expected percentage of density change in one of six possible combinations.

The regional pattern of initial distribution and of projected change of population for each transportation alternative is shown in Table VIII-2. Similar data are presented on a district-by-district basis in Appendix Table A-2. The population impact index values, derived from these data in accordance with the criteria of Table VIII-1, are listed for each transportation alternative, by RPD, in Tables A-3 through A-9, also in the Appendix.

Table VIII-2

REGIONAL POPULATION SHIFTS

	1970 Population Density (persons/acre)	Percent Population Change by Alternative						
		3	4	5	6	7	8	9
Baltimore City	17.96	-3	-4	-6	0	-5	14	8
Anne Arundel County	0.99	34	35	38	98	94	76	55
Baltimore County	1.75	17	16	17	46	39	32	26
Carroll County	0.24	34	27	38	77	81	22	21
Harford County	0.36	47	47	49	90	99	74	67
Howard County	0.43	168	168	165	371	356	309	306
Region	1.44	17	17	16	46	41	40	33

IX. PROJECTED ENVIRONMENTAL IMPACTS

The product of the population impact index value (PI) and the sensitivity index value (SI) is used to designate the expected degree of impact produced by each alternative. The values range from zero to three for both indexes, which result in a combined value range of zero to nine.

For the purpose of assigning an environmental impact index value, the products of PI and SI are aggregated into four groups: the maximum product values of six and nine were assigned the highest impact index value of three, indicating severe impact; product values of four received an impact index value of two, indicating high impact potential; products of one, two, and three were assigned an impact index value of one to signify a moderate potential for impact; the zero level was assigned to those areas having a zero product of the index values; the zero level indicates that little or no impact is expected as a result of population change.

Tables IX-1 through IX-7 summarize the sensitivity-population impact products as well as the distribution of assigned impact values by jurisdiction, showing the number of RPDs in each jurisdiction for each level of aggregated impact. These are tabulated by alternative and followed by a map which graphically illustrates the distribution of impacts by RPD.

Appendix Tables A-3 through A-9 provide detailed data by RPD for the sensitivity index, population impact index, the sensitivity x population impact index, and the aggregated impact index for each alternative.

Table IX-1

REGIONAL ENVIRONMENTAL IMPACTS

1980 Alternative 3 -- Complete 3-A

	Sensitivity Index x Population Impact Index	Number of RPDs by Sensitivity Level (Aggregated Impact Index)				Total
		Severe Impact (Level 3)	High Impact (Level 2)	Moderate Impact (Level 1)	Low Impact (Level 0)	
Baltimore City	6	-	-	5	21	26
Anne Arundel County	47	3	1	12	1	17
Baltimore County	50	1	3	17	10	31
Carroll County	6	-	-	5	1	6
Harford County	5	-	-	3	4	7
Howard County	17	1	-	6	-	7
Regional Total	131	5	4	48	37	94

Note: See Appendix Table A-3, for detailed breakdown of Sensitivity Index, Population Impact Index, and Aggregated Impact Index by individual Regional Planning District.

FIGURE IX-1
REGIONAL PLANNING DISTRICT IMPACT MAP:
1980 ALTERNATIVE 3—COMPLETE 3A

Table IX-2

REGIONAL ENVIRONMENTAL IMPACTS

1980 Alternative 4 -- 3-A less Ft. McHenry Crossing

	Sensitivity Index x Population Impact Index	Number of RPDs by Sensitivity Level (Aggregated Impact Index)				Total
		Severe Impact (Level 3)	High Impact (Level 2)	Moderate Impact (Level 1)	Low Impact (Level 0)	
Baltimore City	6	-	-	5	21	26
Anne Arundel County	47	3	1	12	1	17
Baltimore County	48	1	3	16	11	31
Carroll County	6	-	-	5	1	6
Harford County	7	-	-	4	3	7
Howard County	17	1	-	6	-	7
Regional Total	131	5	4	48	37	94

Note: See Appendix Table A-4, for detailed breakdown of Sensitivity Index, Population Impact Index, and Aggregated Impact Index by individual Regional Planning District.

AGGREGATED IMPACT BY RPD

- SEVERE IMPACT
- HIGH IMPACT
- MODERATE IMPACT
- LOW IMPACT

BALTIMORE
REGIONAL
ENVIRONMENTAL
IMPACT
STUDY
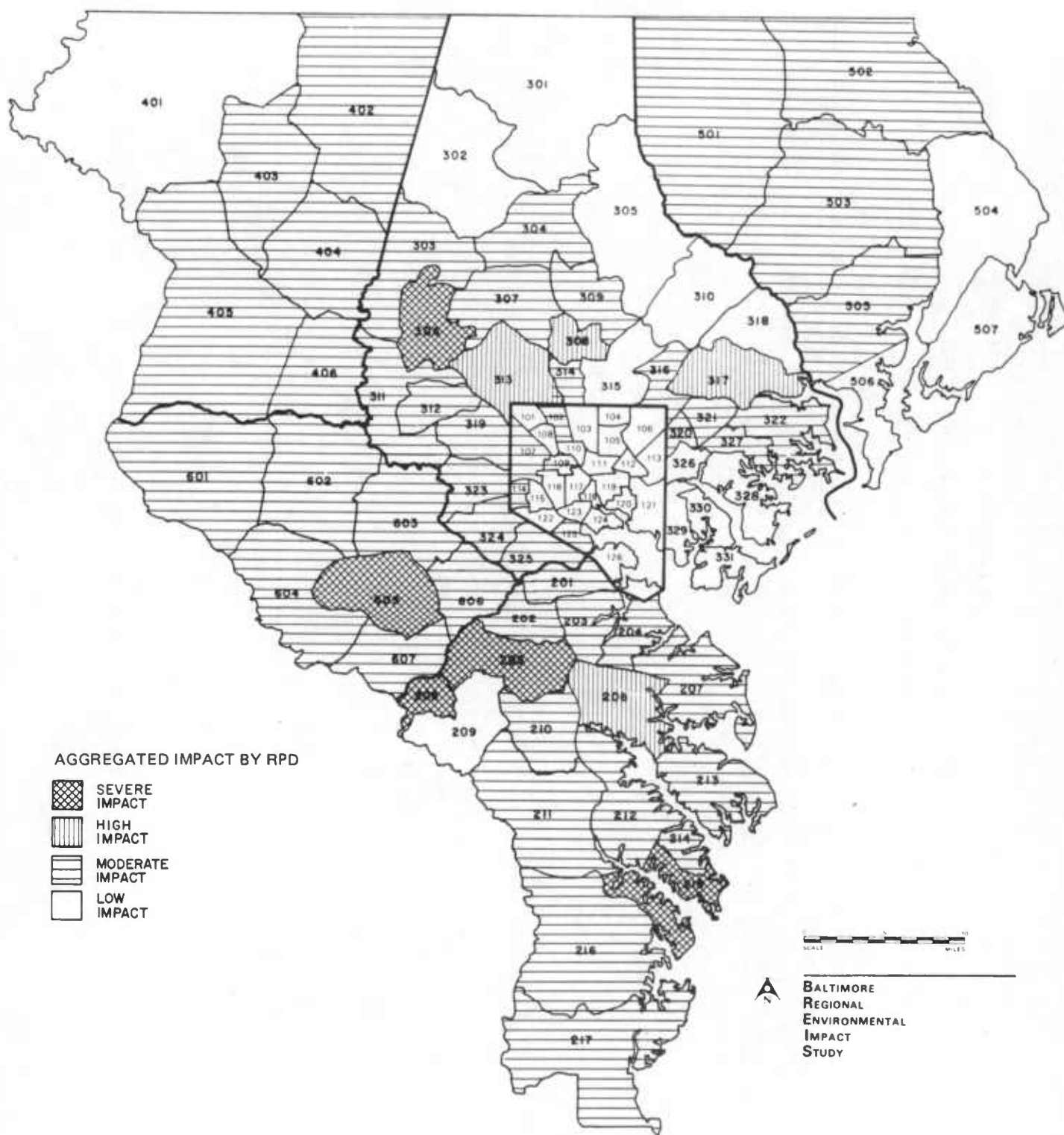
FIGURE IX-2
REGIONAL PLANNING DISTRICT IMPACT MAP:
1980 ALTERNATIVE 4–3-A; LESS FT. McHENRY CROSSING

Table IX-3

REGIONAL ENVIRONMENTAL IMPACTS

1980 Alternative 5 -- No 3-A

	Sensitivity Index x Population Impact Index	Number of RPDs by Sensitivity Level (Aggregated Impact Index)				
		Severe Impact (Level 3)	High Impact (Level 2)	Moderate Impact (Level 1)	Low Impact (Level 0)	Total
Baltimore City	5	-	-	4	22	26
Anne Arundel County	50	3	1	13	-	17
Baltimore County	49	1	3	17	10	31
Carroll County	6	-	-	5	1	6
Harford County	7	-	-	4	3	7
Howard County	17	1	-	6	-	7
Regional Total	134	5	4	49	36	94

Note: See Appendix Table A-5, for detailed breakdown of Sensitivity Index, Population Impact Index, and Aggregated Impact Index by individual Regional Planning District.
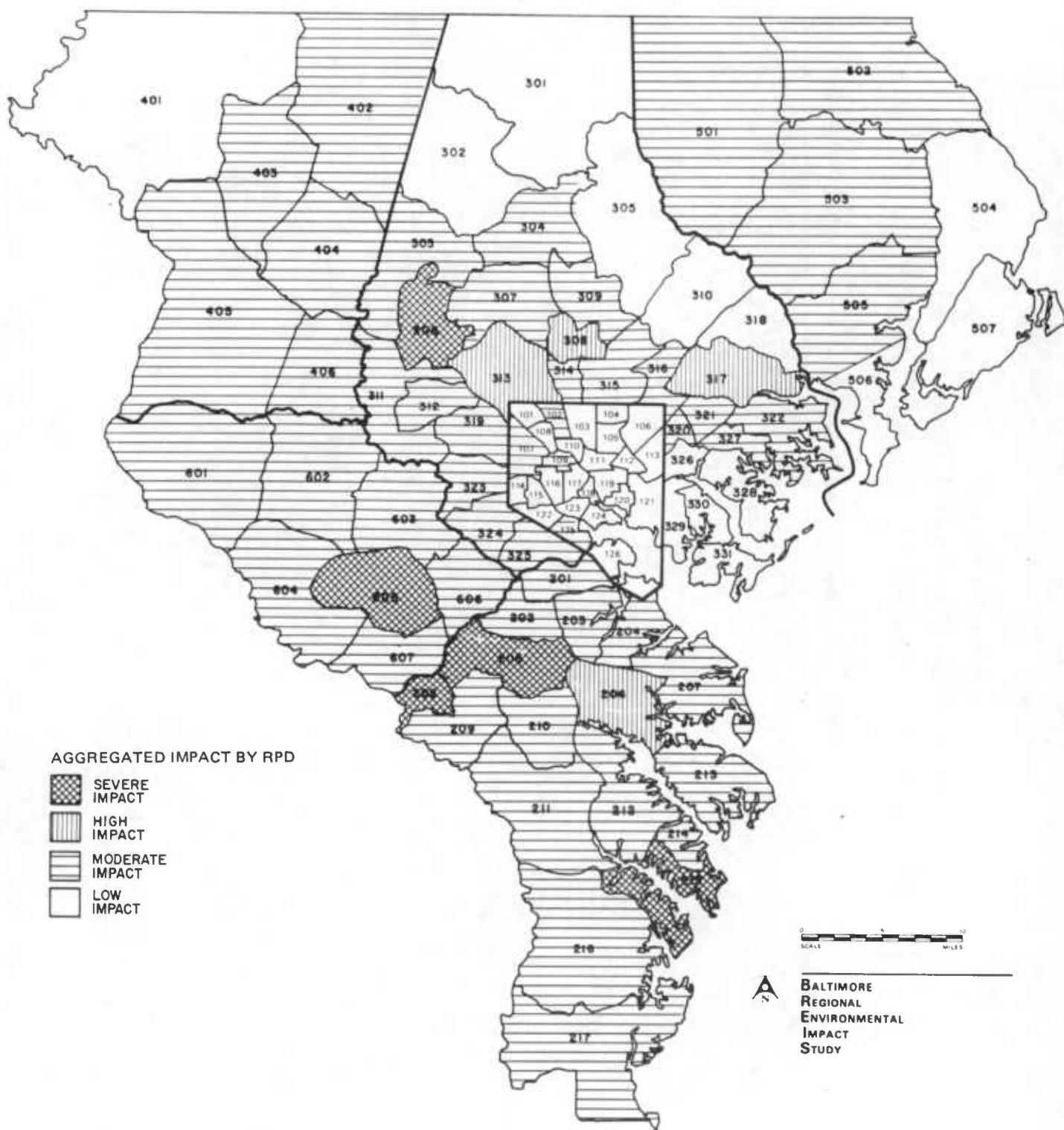
FIGURE IX-3
REGIONAL PLANNING DISTRICT IMPACT MAP:
1980 ALTERNATIVE 5—NO 3-A

AGGREGATED IMPACT BY RPD

SEVERE IMPACT

HIGH IMPACT

MODERATE IMPACT

LOW IMPACT

BALTIMORE
REGIONAL
ENVIRONMENTAL
IMPACT
STUDY

IX-7

Table IX-4

REGIONAL ENVIRONMENTAL IMPACTS

1995 Alternative 6 -- Complete 3-A and GDP Improvements

	Sensitivty Index x Population Impact Index	Number of RPDs by Sensitivity Level (Aggregated Impact Index)				
		Severe Impact (Level 3)	High Impact (Level 2)	Moderate Impact (Level 1)	Low Impact (Level 0)	Total
Baltimore City	7	-	-	6	20	26
Anne Arundel County	81	6	6	5	-	17
Baltimore County	88	6	6	13	6	31
Carroll County	8	-	-	6	-	6
Harford County	12	-	2	3	2	7
Howard County	30	2	-	5	-	7
Regional Total	226	14	14	38	28	94

Note: See Appendix Table A-6, for detailed breakdown of Sensitivity Index, Population Impact Index, and Aggregated Impact Index by individual Regional Planning District.

AGGREGATED IMPACT BY RPD

- SEVERE IMPACT
- HIGH IMPACT
- MODERATE IMPACT
- LOW IMPACT

BALTIMORE
REGIONAL
ENVIRONMENTAL
IMPACT
STUDY
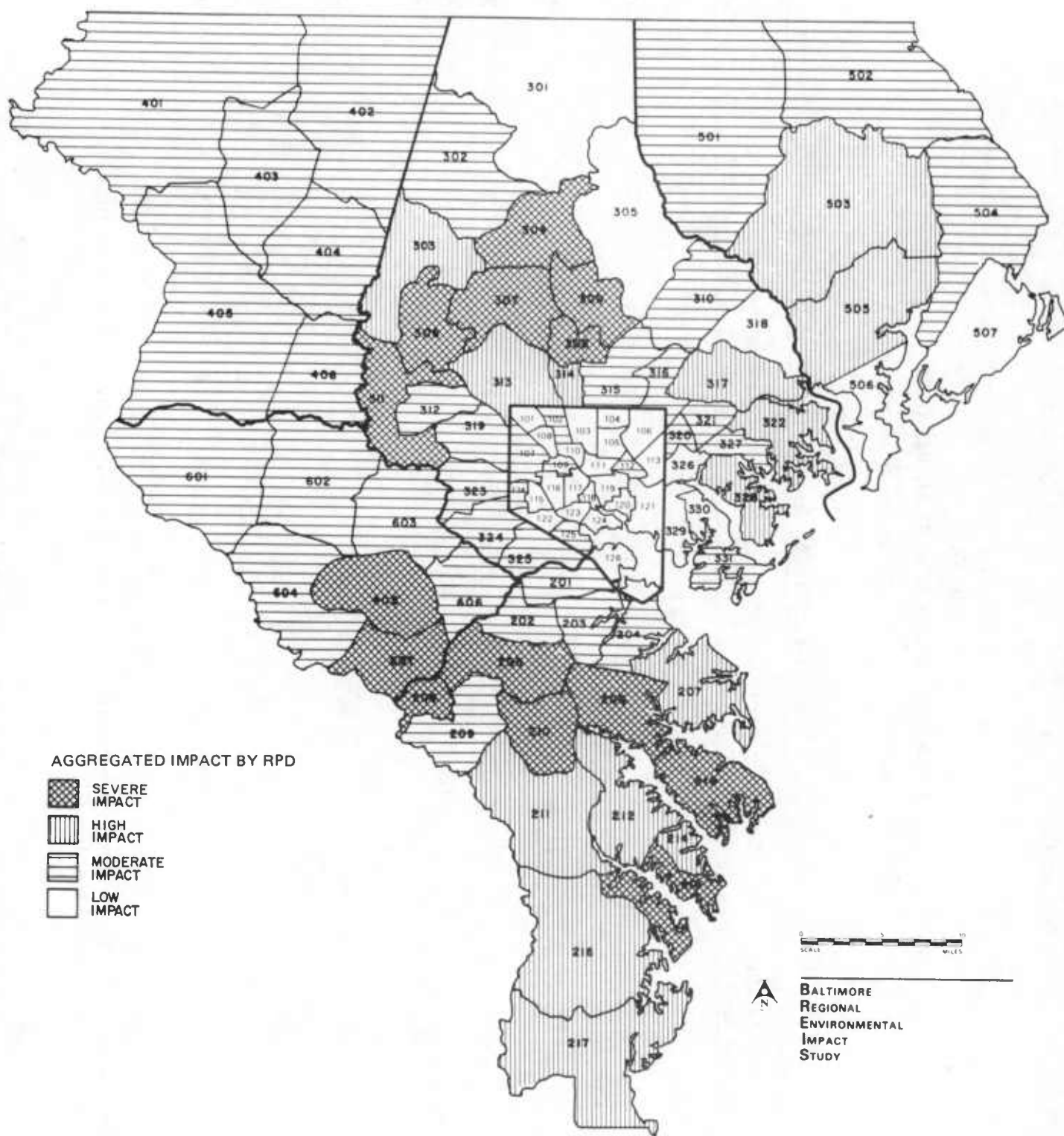
FIGURE IX-4
REGIONAL PLANNING DISTRICT IMPACT MAP:
1995 ALTERNATIVE 6—COMPLETE 3-A AND GDP IMPROVEMENTS

Table IX-5

REGIONAL ENVIRONMENTAL IMPACTS

1995 Alternative 7 -- All GPD Improvements except 3-A

	Sensitivity Index x Population Impact Index	Number of RPDs by Sensitivity Level (Aggregated Impact Index)				Total
		Severe Impact (Level 3)	High Impact (Level 2)	Moderate Impact (Level 1)	Low Impact (Level 0)	
Baltimore City	5	–	–	4	22	26
Anne Arundel County	84	7	6	4	–	17
Baltimore County	82	7	4	12	8	31
Carroll County	8	–	–	6	–	6
Harford County	12	–	2	3	2	7
Howard County	30	2	–	5	–	7
Regional Total	221	16	12	34	32	94

Note: See Appendix Table A-7, for detailed breakdown of Sensitivity Index, Population Impact Index, and Aggregated Impact Index by individual Regional Planning District.

AGGREGATED IMPACT BY RPD

SEVERE
IMPACT

HIGH
IMPACT

MODERATE
IMPACT

LOW
IMPACT

BALTIMORE
REGIONAL
ENVIRONMENTAL
IMPACT
STUDY
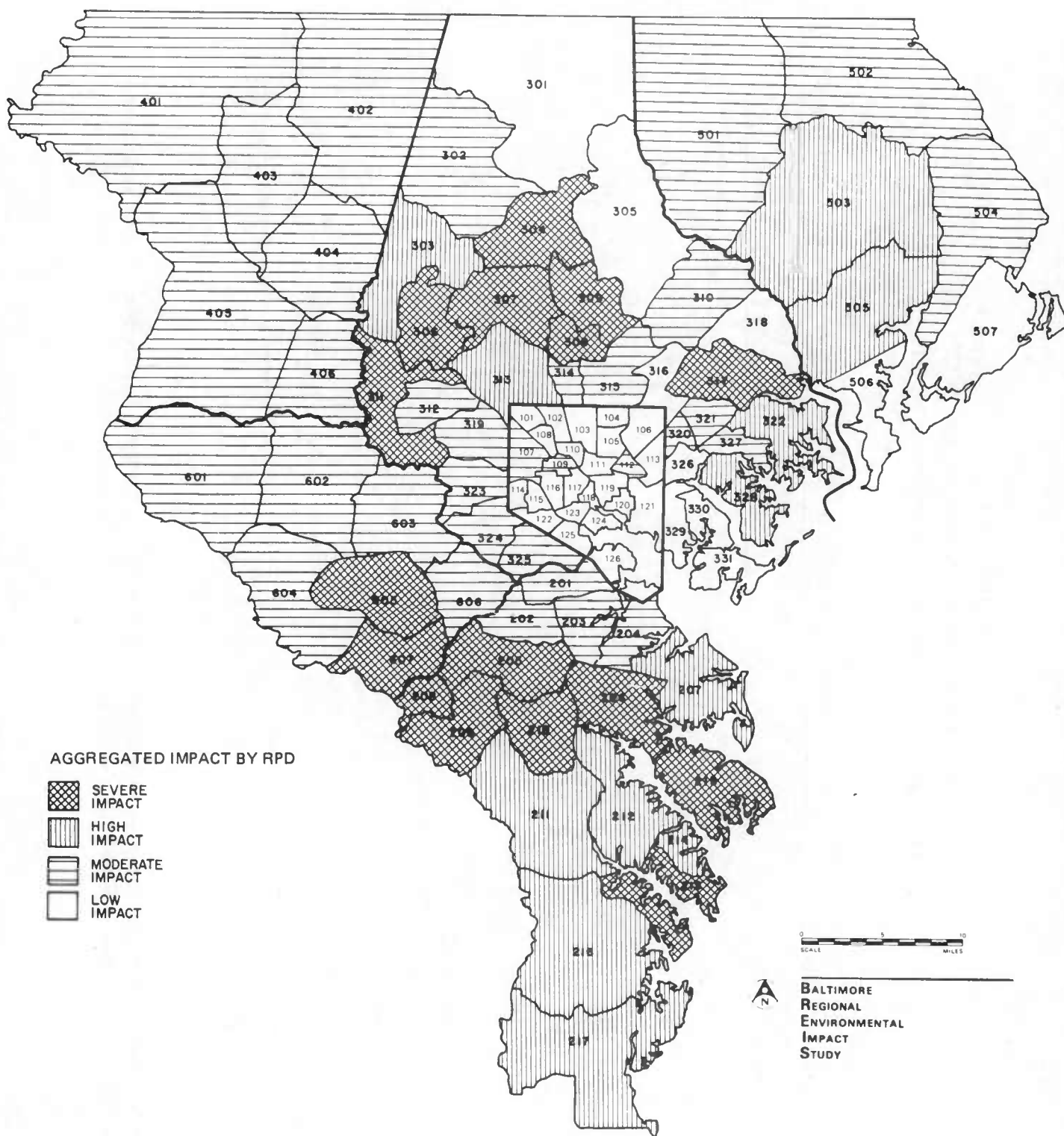
FIGURE IX-5
REGIONAL PLANNING DISTRICT IMPACT MAP:
1995 ALTERNATIVE 7—NO 3-A, ALL GDP IMPROVEMENTS

Table IX-6

REGIONAL ENVIRONMENTAL IMPACTS

1995 Alternative 8 -- Complete 3-A, no other GDP Improvements

	Sensitivity Index x Population Impact Index	Number of RPDs by Sensitivity Level (Aggregated Impact Index)					Total
		Severe Impact (Level 3)	High Impact (Level 2)	Moderate Impact (Level 1)	Low Impact (Level 0)		
Baltimore City	13	-	-	12	14		26
Anne Arundel County	63	3	5	8	1		17
Baltimore County	76	6	2	14	9		31
Carroll County	3	-	-	3	3		6
Harford County	10	-	1	4	2		7
Howard County	30	2	-	5	-		7
Regional Total	195	11	8	46	29		94

Note: See Appendix Table A-8, for detailed breakdown of Sensitivity Index, Population Impact Index, and Aggregated Impact Index by individual Regional Planning District.

AGGREGATED IMPACT BY RPD

- SEVERE IMPACT
- HIGH IMPACT
- MODERATE IMPACT
- LOW IMPACT

BALTIMORE
REGIONAL
ENVIRONMENTAL
IMPACT
STUDY
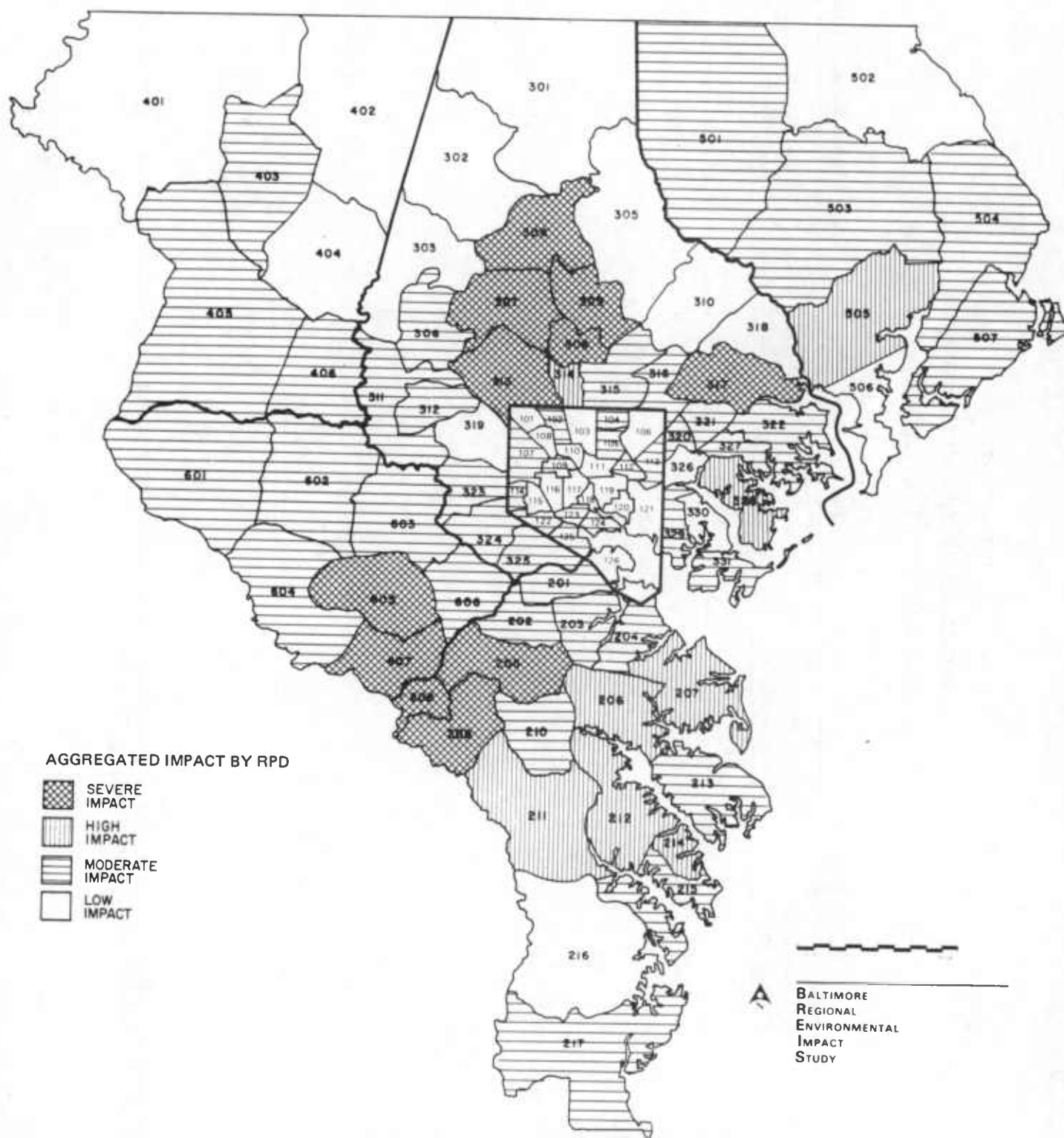
FIGURE IX-6
REGIONAL PLANNING DISTRICT IMPACT MAP:
1995 ALTERNATIVE 8—COMPLETE 3-A, NO GDP IMPROVEMENTS

IX-13

Table IX-7

REGIONAL ENVIRONMENTAL IMPACTS

1995 Alternative 9 -- No 3-A, no GDP Improvements

	Sensitivty Index x Population Impact Index	Number of RPDs by Sensitivity Level (Aggregated Impact Index)				
		Severe Impact (Level 3)	High Impact (Level 2)	Moderate Impact (Level 1)	Low Impact (Level 0)	Total
Baltimore City	11	-	-	8	18	26
Anne Arundel County	61	3	4	9	1	17
Baltimore County	64	4	3	14	10	31
Carroll County	3	-	-	3	3	6
Harford County	8	-	1	3	3	7
Howard County	30	2	-	5	-	7
Regional Total	177	9	8	42	35	94

Note: See Appendix Table A-9, for detailed breakdown of Sensitivity Index, Population Impact Index, and Aggregated Impact Index by individual Regional Planning District.

AGGREGATED IMPACT BY RPD

- SEVERE IMPACT
- HIGH IMPACT
- MODERATE IMPACT
- LOW IMPACT

Baltimore
Regional
Environmental
Impact
Study
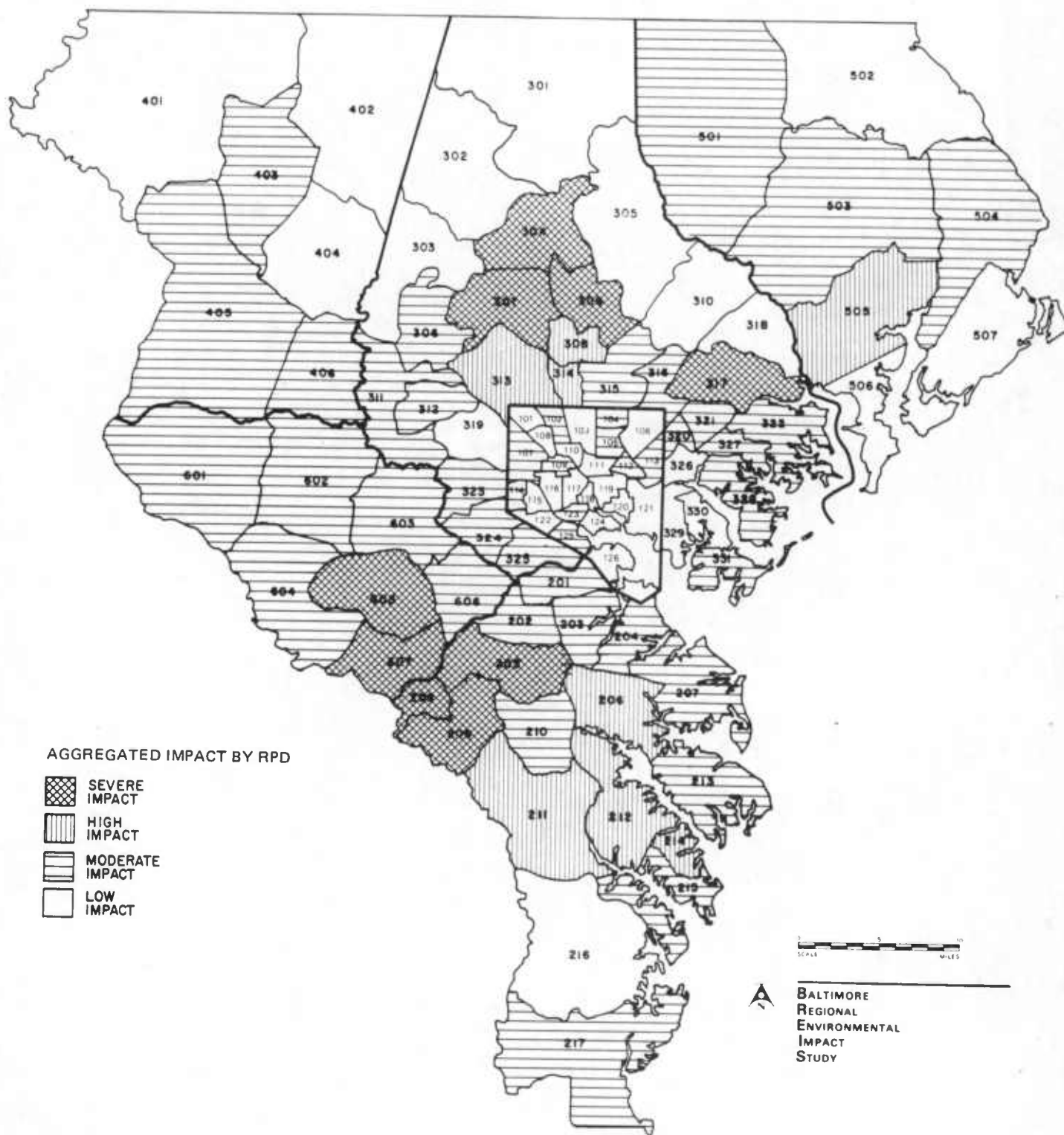
FIGURE IX-7
REGIONAL PLANNING DISTRICT IMPACT MAP:
1995 ALTERNATIVE 9–NO 3-A, NO GDP IMPROVEMENTS

X. IMPACT ANALYSIS AND EVALUATION

INTRODUCTION

The tables and maps presented in the preceding section demonstrate that the regional impacts vary markedly from alternative to alternative. These shifts follow from differences in environmental sensitivity in regional subareas and from differences in the impact of population shifts attributable to the various transportation alternatives.

Subarea Impacts

While the analysis was conducted on a district-by-district basis, a better feeling for the regional implications may be obtained by examining consolidated data for subareas. For example, environmental sensitivities were highest in Baltimore and Anne Arundel Counties and lowest in Howard and Carroll Counties. Similarly, population impacts (summed over all alternatives) were greatest in Baltimore and Anne Arundel Counties and least in Harford and Carroll Counties. As might be expected, on average, Baltimore and Anne Arundel Counties are indicated as the subareas of greatest impact. But the rest of the distribution does not exactly match either the sensitivity or population impact rankings. Rather, the impacts are expected to fall in the following order:

> Baltimore County
>
> Anne Arundel County
>
> Howard County
>
> Harford County
>
> Baltimore City
>
> Carroll County

Population impact appears to play a much larger role in generating total environmental impact than does basic environmental sensitivity when one examines the various alternatives on a regional or subarea basis.

Total Population

Growth in population is bound to affect total environmental impact. There is no basis for comparison of projected 1980 impacts with current impacts. The projected population increase over 1970 levels is about 17 percent.

However, comparison can be made for different alternatives between the situations in 1980 and 1995. During this period, the minimum projected increase of population is about 14 percent, and the maximum about 25 percent. All 1995 impact levels are higher than for 1980. If the increase in impact were solely a function of total population, the impact increases would fall in the same range as the population increase, i.e., 14-25 percent. In fact, the range is actually from about 35 percent to 72 percent. Total population change, therefore, can explain only part of the increase in impact.

Population Distribution

Population distribution emerges as the major determinant of environmental impact. Different transportation alternatives lead to different distributions of total regional population, and these cause differences in total impact, depending on which RPDs are affected. Table X-1 shows the comparison of the no-build alternative with each of the other alternatives in 1980 and 1995, expressed as an index value. In 1980 there is a slightly smaller regional population than the other alternatives but a somewhat greater regional environmental impact for Alternative 5, no 3-A. This can only be explained as the result of differential population distributions among the 1980 alternatives. This position is even more marked when the 1995 alternatives are compared.

CONTRAST OF ALTERNATIVES

1980 Alternatives

The differences in impact among Alternatives 3 (Complete 3-A), 4 (3-A, less Ft. McHenry Crossing), and 5 (No 3-A) are very small. The no-build alternative shows the smallest growth and the greatest impact. The redistribution of population from high density to low density districts accounts for the impact differential in this case. There is no appreciable difference between Alternatives 3 and 4 in either total population or impact. Thus, the Fort McHenry crossing does not appear to make a major contribution to either population distribution or environmental impact at this level of analysis.

1995 Alternatives

Alternative 9 (No 3-A, or other GDP improvements) shows the least population growth and the smallest regional impact of the four 1995 options. As compared to 1980 Alternative 5, there is a regional population increase of 14 percent. The accompanying increase in impacts is 25 percent. The major areas of increased impact are southwest of Baltimore City in Howard

Table X-1

COMPARISON OF 1980 AND 1995 POPULATION VERSUS IMPACT

	Alternative	Impact Index Total As Percent of: Alternative 5	Population As Percent of: Alternative 5
1980	3 -- Complete 3-A	98	101
	4 -- 3-A less Ft. McHenry Crossing	98	101
	5 -- No 3-A	100	100

		Alternative 9	Alternative 9
1995	6 -- Complete 3-A and GDP Improvements	128	110
	7 -- All GDP Improvements except 3-A	125	108
	8 -- Complete 3-A, no Other GDP Improvements	101	104
	9 -- No 3-A, no GDP Improvements	100	100

and Anne Arundel Counties and in Baltimore County north and northeast of the City. It is this distributional placement of population increments in areas of extreme and high sensitivity that results in impact levels much higher than gross population growth.

Alternative 8 (3-A, no other GDP improvements) shows much the same impact pattern as Alternative 9. Total population is 20 percent greater than for Alternative 5 and 4 percent greater than for Alternative 9. Impacts are also up sharply; 45 percent over Alternative 5 and 11 percent over Alternative 9. As compared to Alternative 9, there are more people located in southeastern and central Baltimore County, in southeastern Harford County, and in northeastern Anne Arundel County. The increased population in sensitive areas accounts for the higher impact with this alternative.

With the introduction of the GDP improvements, the impacts rise sharply. Alternative 7 (No 3-A, all other GDP improvements) leads to a population increase of 22 percent and an impact increment of 65 percent as compared to Alternative 3 of 1980. Growths in population and impact, as compared to the 1995 no-build plan (Alternative 9), are 8 percent and 25 percent, respectively. Thus, the increase in impact far outstrips simple population growth. This increase is related to a large impact increase in Anne Arundel County and somewhat lesser increases in impacts in Baltimore, Carroll, and Harford Counties. This alternative leads to a 12 percent decrease in population within the Baltimore City, the redistribution of which, undoubtedly, accounts for a substantial part of the increase in regional impact.

Finally, Alternative 6 (3-A, and all other GDP improvements) shows both the greatest population increase and the largest impact of all the cases examined. Regional population is up 25 percent over Alternative 3 and 10 percent over Alternative 9. The impacts are 69 percent greater than for Alternative 3 and 28 percent greater than for Alternative 9. Baltimore City's population is larger by 5 percent than for Alternative 7, reflecting the general tendency of the 3-A system to favor retention of population in the city. Net population increase over the no-build alternative is somewhat less in Carroll and Harford Counties. Two areas of extreme impact are reduced to a lower level, and five other areas of low or moderate impact experience escalation in impact. Thus, the increase in impact for this alternative is a function of both regional population increases and redistribution of population within the region to areas of greater sensitivity.

IMPACT PERSPECTIVE

As noted, the most severe impacts are associated with Alternative 6 (3-A, and all other GDP improvements), with Alternative 7 (No 3-A, all other GDP

improvements) close behind. Alternatives 8 (3-A, no other GDP improve-
ments) and 9 (No 3-A, or other GDP improvements) result in considerably
lower levels of regional impact, although the Alternative 8 level is
slightly higher than for Alternative 9. The conclusion is that it is the
GDP which makes the major contribution to environmental impact in the 1995
time frame. The contribution of the 3-A system is much less significant.
Since Alternative 6, which has been the result of the most extensive
planning efforts of all the cases examined, results in the most severe
impacts, it would appear desirable to examine this option (and Alter-
native 7) carefully to determine what parts of the complete GDP system
cause the increases in impacts. The objective should be to determine
whether the projected population growth and increase in economic activity
justify the expected environmental damage. Possible means for eliminating
or lessening undesirable impacts should also be sought.

The 3-A system appears to have relatively little impact on the region
outside of Baltimore City. In 1980, it leads to a small increase in re-
gional population over not building the 3-A. The impacts associated with
complete 3-A (Alternative 3) and partial 3-A (Alternative 4) are actually
somewhat lower than those projected for the 1980 Alternative 5, in spite of
the small increase in regional population within Baltimore City when the 3-A
system is built as compared to the situation without it.

The picture concerning 3-A is much the same for the 1995 alternatives.
Comparison of alternative pairs (6 and 7) and (8 and 9) indicate that the major
differential impacts on both population growth and the environment are
associated with the GDP, not 3-A. Thus, it appears from the findings of
this study that the 3-A system will not have a significant regional impact
on the environment in either 1980 or 1995.

REFERENCES

1. Board of Natural Resources, The Physical Features of Carroll County and Frederick County, Department of Geology, Mines and Water Resources, State of Maryland, 1946.

2. Bulletin of the Maryland Herpetological Society, Vol. 5 #4, The Natural History Society of Maryland, Inc., 1969.

3. Caulk, E. T., Some Common Birds of Maryland, Maryland Department of Game and Inland Fish, 1965.

4. Class, Ernst, G.W. Fisher, and C.A. Hopson, The Geology of Howard and Montgomery Counties, Maryland Geological Survey, 1964.

5. Cleaves, E.T. et. al, Geologic Maps of Maryland, Maryland Geological Survey, 1968.

6. Cleaves, E.T., Piedmont and Coastal Plain Geology Along the Susquehanna Aqueduct, Baltimore to Aberdeen, Maryland, Report of Investigations No. 8, Maryland Geological Survey, 1968.

7. Collin, Martin L., Land Urbanization Potentials of the Baltimore Region Based on Natural Criteria, Regional Planning Council, Baltimore, Maryland, 1970.

8. _____ Natural Criteria For Land Use, Regional Planning Council, Baltimore, Maryland, 1970.

9. Crowley, W.P. et al., New Interpretations of the Eastern Piedmont of Maryland, Guidebook No. 2, Maryland Geological Survey, 1971.

10. Ferguson, R.H., The Timber Resources of Maryland, U.S. Forest Service, Resource Bulletin NE-7, 1967.

11. Frony, R. and Dennis Slifer, Coves of Maryland, Educational Series No. 3, Maryland Geological Survey, 1971.

12. Gernont, R.E., T.G. Gibson and F.C. Whitmore, Environmental History of Maryland Miocene, Guidebook No. 3, Maryland Geological Survey, 1971.

13. Martin, R.O., R.J. Dingman, and H.F. Ferguson, The Water Resources of Baltimore and Harford Counties, Dept. of Geology, Mines, and Water Resources, Bulletin #17, 1956.

14. Maryland Dept. of Natural Resources, Fisheries Administration, (Personal Communication).

15. _____ Forest Service (Personal Communication).

16. _____ Maryland Geological Survey, 1901, Eocene, Baltimore, Maryland.

17. _____ Maryland Geological Survey, 1904, Miocene, Baltimore, Maryland.

18. _____ Maryland Geological Survey, 1906, Pliocene and Pleistocene, Baltimore, Maryland.

19. _____ Official List of Endangered Species for Maryland, (Personal Communication January 8, 1973).

20. _____ Wildlife Administration (Personal Communication).

21. Maryland Dept. of State Planning, Catalog of Natural Areas in Maryland, Publication #148, Baltimore, Maryland, 1968.

22. _____ Groundwater Aquifers and Mineral Commodities of Maryland, Publication #152, Baltimore, Maryland, 1969.

23. _____ Integrity of the Chesapeake Bay, Publication #184, Baltimore, Maryland, 1972.

24. _____ Maryland Outdoors Recreation and Openspace Plan, Comprehensive Plan II, Publication #75, Baltimore, Maryland, 1973.

25. Maryland Herpetological Society, Endangered Amphibians and Reptiles of Maryland, Ad Hoc Committee on Rare and Endangered Amphibians and Reptiles of Maryland.

26. Mock, F.K., Groundwater Supplies for Industrial and Urban Development in Anne Arundel County, Dept. of Geology, Mines and Water Resources, Bulletin #26, 1962.

27. Otton, E.G., Solid-Waste Disposal in the Geohydrologic Environment of Maryland, Report of Investigations No. 18, Maryland Geological Survey, 1972.

28. Patuxent Wildlife Research Station (Personal Communication).

29. Regional Planning Council, General Development Plan for the Baltimore Region, Regional Planning Council, 701 St. Paul Street, Baltimore, Maryland, 1972.

30. Robbins, C.S., Rare or Endangered Breeding Birds of Maryland, (Preliminary Draft).

31. Robbins, C.S. and W.T. Van Velzen, The Breeding Bird Survey, 1967 and 1968, Bureau of Sport Fisheries and Wildlife Special Scientific Report--Wildlife #124, 1969.

32. Smithsonian Institute, Washington, D.C. (Personal Communication).

33. Southwick, D.L., J.P. Owens, and J. Edwards Jr., The Geology of Harford County, Maryland, Maryland Geologic Survey, 1969.

34. University of Maryland at Baltimore, Depts. of Zoology and Botany, (Personal Communication).

35. USDI Fish and Wildlife Service Bureau of Sport Fisheries and Wildlife (Personal Communication).

36. Vokes, Harold E., Geography and Geology of Maryland: Maryland Geological Survey Bulletin #19, 1957.

37. Walker, P.N., Flow Characteristics of Maryland Streams, Report of Investigations No. 16, Maryland Geological Survey, 1971.

38. Webb, W.E. and S.G. Heidel, Extent of Brackish Water in the Tidal Rivers of Maryland, Report of Investigations No. 13, Maryland Geological Survey, 1970.

APPENDIX

TABLE A-1   ENVIRONMENTAL SENSITIVITY INDEX

RPD	GEOLOGICAL-PHYSICAL	BIOLOGICAL	WATER	POTENTIAL FOR IMPACT	TOTAL	COMBINED SENSITIVITY INDEX
101	1	0	0	0	0	0
102	1	3	0	+	4	1
103	2	1	0	0	0	0
104	2	0	0	+	2	1
105	2	2	1	+	5	1
106	2	0	0	0	0	0
107	1	3	1	+	5	1
108	1	2	0	+	3	1
109	2	1	0	+.	3	1
110	1	0	0	0	0	0
111	2	0	0	0	0	0
112	2	3	0	+	2	1
113	2	0	0	+	2	1
114	1	0	0	+	1	1
115	1	2	1	+	4	1

TABLE A-1   ENVIRONMENTAL SENSITIVITY INDEX - CONTINUED

RPD	GEOLOGICAL-PHYSICAL	BIOLOGICAL	WATER	POTENTIAL FOR IMPACT	TOTAL	COMBINED SENSITIVITY INDEX
116	1	2	1	+	4	1
117	2	0	0	0	0	0
118	2	0	0	0	0	0
119	2	0	0	0	0	0
120	2	0	0	0	0	0
121	1	1	1	+	3	1
122	2	0	0	+	2	1
123	1	0	0	+	1	1
124	1	0	1	+	2	1
125	2	2	1	+	5	1
126	1	2	1	+	4	1
201	2	1	0		3	1
202	3	1	2		6	2
203	2	1	1		4	1
204	3	1	0		4	1

TABLE A-1   ENVIRONMENTAL SENSITIVITY INDEX - CONTINUED

RPD	GEOLOGICAL-PHYSICAL	BIOLOGICAL	WATER	TOTAL	COMBINED SENSITIVITY INDEX
205	3	3	2	8	3
206	3	2	2	7	2
207	2	3	2	7	2
208	3	3	3	9	3
209	3	3	3	9	3
210	3	3	3	9	3
211	2	3	2	7	2
212	2	3	2	7	2
213	3	3	2	8	3
214	2	3	2	7	2
215	3	3	2	8	3
216	1	3	2	6	2
217	2	3	2	7	2
301	0	3	3	6	2

TABLE A-1   ENVIRONMENTAL SENSITIVITY INDEX - CONTINUED

RPD	GEOLOGICAL-PHYSICAL	BIOLOGICAL	WATER	TOTAL	COMBINED SENSITIVITY INDEX
302	0	3	3	6	2
303	1	3	3	7	2
304	2	3	3	8	3
305	0	3	2	5	1
306	1	3	2	6	2
307	1	3	3	7	2
308	3	3	1	7	2
309	2	3	3	8	3
310	2	3	1	6	2
311	2	3	1	6	2
312	2	1	2	5	1
313	2	3	1	6	2
314	3	3	1	7	2
315	3	2	0	5	1
316	3	1	0	4	1

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TABLE A-1   ENVIRONMENTAL SENSITIVITY INDEX - CONTINUED

RPD	GEOLOGICAL-PHYSICAL	BIOLOGICAL	WATER	TOTAL	COMBINED SENSITIVITY INDEX
317	3	2	1	6	2
318	2	3	2	7	2
319	2	1	0	3	1
320	2	0	0	2	1
321	1	0	0	1	1
322	3	3	1	7	2
323	2	1	0	3	1
324	2	1	0	3	1
325	3	2	0	5	1
326	2	1	0	3	1
327	3	1	1	5	1
328	2	3	1	6	2
329	2	1	1	4	1
330	2	3	1	6	2

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TABLE A-1   ENVIRONMENTAL SENSITIVITY INDEX - CONTINUED

RPD	GEOLOGICAL-PHYSICAL	BIOLOGICAL	WATER	TOTAL	COMBINED SENSITIVITY INDEX
331	2	3	1	6	2
401	0	2	3	5	1
402	1	2	3	6	2
403	1	1	3	5	1
404	0	2	3	5	1
405	0	2	3	5	1
406	0	2	3	5	1
501	0	2	1	3	1
502	1	2	3	6	2
503	2	1	3	6	2
504	2	2	1	5	1
505	3	2	1	6	2
506	3	3	1	7	2
507	2	3	1	6	2
601	0	2	3	5	1
602	0	2	3	5	1

TABLE A-1   ENVIRONMENTAL SENSITIVITY INDEX - CONTINUED

RPD	GEOLOGICAL-PHYSICAL	BIOLOGICAL	WATER	TOTAL	COMBINED SENSITIVITY INDEX
603	1	1	3	5	1
604	0	2	3	5	1
605	3	2	3	8	3
606	3	1	1	5	1
607	3	3	3	9	3

TABLE A-2   POPULATION CHANGE BY ALTERNATIVE

ALTERNATIVES	1	3	4	5	6	7	8	9
101	12.6841	8.486%	9.179%	10.82%	16.25%	19.26%	22.34%	25.81%
102	5.1423	43.58%	44.02%	29.13%	44.69%	34.16%	62.75%	45.80%
103	8.3114	-2.03%	-0.27%	-2.01%	2.42%	2.43%	19.58%	17.23%
104	19.8671	-5.13%	-3.56%	-3.64%	2.29%	2.85%	17.36%	18.31%
105	19.6400	-2.4%	-.047%	.085%	3.2%	1.23%	22.63%	17.58%
106	14.2841	1.11%	3.13%	3.06%	3.67%	1.30%	19.87%	16.91%
107	14.0636	8.15%	7.51%	5.69%	14.51%	14.11%	15.93%	17.23%
108	35.5266	1.13%	1.48%	1.80%	5.54%	5.43%	11.13%	11.69%
109	13.7685	14.51%	15.11%	12%	22.72%	16.79%	37.67%	31.12%
110	18.1804	18.12%	18.54%	17.68%	17.05%	18.71%	28.53%	31.62%
111	32.4253	-9.64%	-9.31%	-11.68%	-0.01%	2.90%	22.44%	14.32%
112	17.1492	-1.72%	-0.017%	1.5%	20.86%	19.91%	43.52%	45.03%
113	14.1088	-2.0%	-3.33%	1.30%	2.31%	0.056%	13.04%	13.97%
114	12.2410	8.27%	6.79%	0.076%	17.59%	-0.053%	26.78%	13.32%
115	20.5965	4.84%	3.15%	-1.86%	4.28%	-4.86%	17.93%	2.32%
116	35.9109	0.07%	-0.05%	-7.08%	0.012%	-14.74%	15.75%	-0.09%
117	54.7127	-13.15%	-12.47%	-14.64%	-17.02%	-22.13%	-1.17%	-7.51%

TABLE A-2   POPULATION CHANGE BY ALTERNATIVE

ALTERNATIVES	1	3	4	5	6	7	8	9
118	18.1308	48.70%	50.21%	42.83%	77.39%	150.83%	82.71%	127.88%
119	47.8929	-19.90%	-18.77%	-23.01%	-18.11%	-28.68%	-1.0%	-12.80%
120	43.9566	-22.25%	-23.61%	-32.39%	-21.73%	-40.95	-6.64%	-24.03%
121	5.6391	-12.60%	-20.53%	-23.31%	-19.67%	-28.92%	-6.63%	-15.52%
122	10.8536	1.12%	0.178%	-7.48%	-3.43%	-11.35%	9.31%	-1.71%
123	10.4897	-8.2%	-10.70%	-12.37%	-9.95%	-9.09%	6.83%	9.6%
124	17.3616	3.81%	-8.83%	-23.64%	-7.68%	-34.19%	9.58%	-18.03%
125	15.3698	7.70%	6.06%	6.71%	12.21%	0.04%	26.2%	17.13%
126	5.1409	0.068%	-0.018%	-1.22%	-0.08%	-5.39%	1.62%	3.81%
201	3.4955	23.25%	23.74%	27.34%	39.60%	31.91%	45.30%	40.23%
202	0.4042	25.38%	24.99%	29.09%	44.98%	40.50%	66.20%	34.54%
203	6.2172	12.37%	13.56%	16.02%	30.87%	24.97%	13.09%	13.60%
204	1.5331	70.10%	74.80%	82.07%	160.86%	150.24%	136.15%	143.69%
205	1.2079	55.55%	56.82%	59.86%	203.64%	194.63%	145.38%	148.36%
206	2.6723	37.01%	39.30%	41.21%	143.95%	137.42%	45.20%	27.71%
207	1.3173	39.54%	41.76%	43.98%	94.74%	89.49%	56.55%	23.55%

TABLE A-2   POPULATION CHANGE BY ALTERNATIVE

ALTERNATIVES	1	3	4	5	6	7	8	9
208	1.7960	62.61%	62.82%	65.23%	134.68%	126.77%	125.21%	113%
209	1.1896	3.19%	3.53%	5.61%	25.69%	65.85%	75.39%	83.76%
210	0.8222	45.10%	46.63%	50.05%	122.59%	113.43%	43.89%	47.15%
303	0.1496	47.93%	48.40%	55.35%	147.39%	155.41%	0	-6.48%
304	0.1469	36.96%	38.87%	38.26%	171.20%	165.42%	158.68%	149.90%
305	0.1778	10.74%	12.43%	13.61%	14.29%	16.65%	-8.55%	-9.56%
306	2.0317	56.09%	57.35%	64.87%	157.17%	163.1%	7.67%	13.16%
307	0.1874	51.17%	51.97%	47.81%	251.97%	237.19%	234.53%	200.85%
308	3.2610	35.79%	37.83%	36.98%	52.21%	52.75%	50.94%	45.88%
309	1.5153	39.07%	41.09%	39.87%	60.44%	58.96%	57.47%	50.39%
310	0.3027	8.23%	9.94%	11.76%	86.92%	89.82%	-0.01%	+0.02%
311	0.2750	33.42%	33.45%	34.47%	332.69%	345.52%	32.25%	40.36%
312	3.2345	34.26%	34.80%	39.38%	139.51%	145.18%	52.86%	44.17%
313	1.7169	60.75%	61.95%	53.42%	95%	84.91%	103.13%	83.92%
314	2.1496	11.50%	12.59%	13.07%	21.61%	6.88%	30.32%	26.78%
315	6.9020	1.87%	3.52%	5.94%	9.45%	10.76%	25.38%	27.27%
316	6.1256	6.22%	6.38%	11.05%	3.35%	4.39%	10.11%	11.05%

TABLE A-2   POPULATION CHANGE BY ALTERNATIVE

ALTERNATIVES	1	3	4	5	6	7	8	9
317	1.1770	77%	75.22%	79.30%	150.13%	142.26%	149.85%	137.69%
318	0.3555	5.37%	4.05%	5.18%	9.99%	7.99%	-18.96%	-23.04%
319	5.7753	10.49%	10.67%	10.59%	32.07%	34.51%	-9.12%	-3.4%
320	7.5411	10.07%	8.49%	13.89%	27.44%	23.78%	38.91%	36.54%
321	0.6511	144.11%	140.03%	146.03%	194.13%	185.36%	230.41%	180.62%
322	0.8361	73.02%	68.64%	69.54%	144.72%	135.96%	71.34%	60.95%
323	3.8740	33.38%	33.25%	27.10%	62.26%	25.54%	83.72%	60.62%
324	4.1630	32.48%	31.66%	27.69%	51.37%	37.83%	57.94%	45.71%
325	5.9257	8.95%	8.12%	6.53%	22.09%	11.19%	30.60%	25.59%
326	3.9267	-11.66%	-14.56%	-12.01%	-6.76%	-12.19%	-7.66%	-12.71%
327	3.3188	34.08%	31.98%	31.38%	62.71%	55.94%	33.34%	26.09%
328	5.4752	5.78%	2.33%	2.61%	47.80%	40%	32.09%	19.61%
329	11.3888	-7.58%	-11.38%	-11.44%	-5.59%	-14.24%	5.99%	0.02%
330	6.7570	-5.74%	-11.29%	-11.81%	-1.11%	-11.21%	8.31%	-1.72%
331	1.8379	0.05%	0.09%	2.08%	5.07%	0.02%	20.88%	18.25%
603	0.9264	61.95%	61.78%	62.17%	175.26%	170.28%	145.16%	136.57%

TABLE A-2   POPULATION CHANGE BY ALTERNATIVE

ALTERNATIVES	1	3	4	5	6	7	8	9
604	0.4537	46.82%	46.99%	46.62%	454.84%	443.42%	324.22%	344.02%
605	0.7160	563.25%	562.70%	553.72%	702.35%	676.84%	576.61%	590.36%
606	0.7448	51.88%	51.27%	46.47%	414.11%	388.14%	347.49%	305.93%
607	0.6575	81.13%	81.34%	80.79%	374.69%	356.02%	356.33%	369.93%
211	0.3038	43.94%	44.93%	46.45%	137.23%	129.03%	113.13%	116.62%
212	0.5722	41.09%	42.19%	43.59%	165.94%	163.02%	136.89%	137.71%
213	0.8842	64.19%	65.75%	67.72%	130.25%	127.87%	88.93%	84.54%
214	8.4325	14.2%	15.06%	16.94%	41.72%	40.37%	24.68%	23.26%
215	1.2703	57.88%	58.88%	60.34%	133.91%	132.60%	20.51%	21.21%
216	0.1196	28.68%	29.43%	30.69%	115.22%	114.38%	5.10%	5.69%
217	0.2995	42.20%	42.74%	43.91%	171.62%	171.39%	87.04%	88.21%
301	0.1142	8.49%	9.89%	9.19%	13.66%	11.47%	7.27%	3.33%
302	0.1044	12.84%	13.89%	18.%	76.82%	78.45%	-18.20%	-20.40%
401	0.1348	13.06%	13.20%	15.58%	29.90%	31.97%	-3.71%	-4.53%
402	0.1982	31.33%	31.84%	35.07%	54.14%	60.04%	4.69%	3.43%
403	0.5490	39.14%	39.56%	43.50%	79.84%	85.26%	40.18%	39.54%

TABLE A-2   POPULATION CHANGE BY ALTERNATIVE

ALTERNATIVES	1	3	4	5	6	7	8	9
404	0.2209	39.38%	39.70%	43.96%	76.28%	80.44%	3.94%	3.80%
405	0.1707	28.35%	28.70%	32.16%	58.52%	62.80%	47.33%	45.75
406	0.6204	51.82%	51.85%	57.35%	166.36%	167.30%	21.71%	25.19%
501	0.1275	25.88%	27.69%	28.78%	65.65%	68.47%	13.96%	12.16%
502	0.1740	19.60%	21.15%	22.13%	50.17%	51.84%	-11.15%	-11.55%
503	0.5040	47.06%	46.27%	48.97%	104.25%	113.89%	54.66%	48.25%
504	0.7965	13.92%	13.45%	14.39%	31.54%	28.56%	42.50%	36.84%
505	0.6776	69.21%	68.08%	71.13%	117.95%	111.28%	133.38%	122.82%
506	0.1099	7%	6.46%	8.37%	-1.54%	-4.64%	-5.73%	-9.92%
507	0.2645	-23.63%	-23.74%	-23.02%	13.27%	10.70%	18.64%	14.48%
601	0.1046	27.53%	27.25%	27.63%	51.43%	50.10%	51.34%	49.71%
602	0.1293	40.53%	40.14%	39.29%	235.65%	232.87%	218.10%	213.30%

TABLE A-3   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 3

BALTIMORE CITY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
101	0	1	0	0
102	1	2	2	1
103	0	0	0	0
104	1	0	0	0
105	1	0	0	0
106	0	0	0	0
107	1	1	1	1
108	1	0	0	0
109	1	1	1	1
110	0	1	0	0
111	0	0	0	0
112	1	0	0	0
113	1	0	0	0
114	1	1	1	1

TABLE A-3   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 3 - CONTINUED

BALTIMORE CITY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
115	1	0	0	0
116	1	0	0	0
117	0	0	0	0
118	0	1	0	0
119	0	0	0	0
120	0	0	0	0
121	1	0	0	0
122	1	0	0	0
123	1	0	0	0
124	1	0	0	0
125	1	1	1	1
126	1	0	0	0

TOTAL OF BALTIMORE CITY = 6

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TABLE A-3   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 3 - CONTINUED

ANNE ARUNDEL COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
201	1	2	2	1
202	2	1	2	1
203	1	1	1	1
204	1	2	2	1
205	3	2	6	3
206	2	2	4	2
207	2	1	2	1
208	3	2	6	3
209	3	0	0	0
210	3	1	3	1
211	2	1	2	1
212	2	1	2	1
213	3	1	3	1
214	2	1	2	1
215	3	2	6	3
216	2	1	2	1
217	2	1	2	1

TOTAL OF ANNE ARUNDEL COUNTY = 47

TABLE A-3   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 3 - CONTINUED

BALTIMORE COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
301	2	0	0	0
302	2	0	0	0
303	2	1	2	1
304	3	1	3	1
305	1	0	0	0
306	2	3	6	3
307	2	1	2	1
308	2	2	4	2
309	3	1	3	1
310	2	0	0	0
311	2	1	2	1
312	1	2	2	1

TOTAL OF BALTIMORE COUNTY = 24

TABLE A-3   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 3 - CONTINUED

BALTIMORE COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
313	2	2	4	2
314	2	1	2	1
315	1	0	0	0
316	1	1	1	1
317	2	2	4	2
318	2	0	0	0
319	1	1	1	1
320	1	1	1	1
321	1	2	2	1
322	2	1	2	1
323	1	2	2	1
324	1	2	2	1
325	1	1	1	1
326	1	0	0	0
327	1	2	2	1

TABLE A-3   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 3 - CONTINUED

BALTIMORE COUNTY - continued

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
328	2	1	2	1
329	1	0	0	0
330	2	0	0	0
331	2	0	0	0

TOTAL OF BALTIMORE COUNTY = 50

CARROLL COUNTY

401	1	0	0	0
402	2	1	2	1
403	1	1	1	1
404	1	1	1	1
405	1	1	1	1
406	1	1	1	1

TOTAL OF CARROLL COUNTY = 6

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TABLE A-3   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 3 - CONTINUED

HARFORD COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX x POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
501	1	1	1	1
502	2	0	0	0
503	2	1	2	1
504	1	0	0	0
505	2	1	2	1
506	2	0	0	0
507	2	0	0	0

TOTAL OF HARFORD COUNTY = 5

HOWARD COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX x POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
601	1	1	1	1
602	1	1	1	1
603	1	1	1	1
604	1	1	1	1
605	3	3	9	3

TABLE A-3   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 3 - CONTINUED

HOWARD COUNTY - continued

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
606	1	1	1	1
607	3	1	3	1

TOTAL OF HOWARD COUNTY = 17

TOTAL SENSITIVITY INDEX X POPULATION IMPACT INDEX = 131

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TABLE A-4   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 4

BALTIMORE CITY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
101	0	1	0	0
102	1	2	2	1
103	0	0	0	0
104	1	0	0	0
105	1	0	0	0
106	0	0	0	0
107	1	1	1	1
108	1	0	0	0
109	1	1	1	1
110	0	1	0	0
111	0	0	0	0
112	1	0	0	0
113	1	0	0	0
114	1	1	1	1

TABLE A-4   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 4 - CONTINUED

BALTIMORE CITY - continued

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
115	1	0	0	0
116	1	0	0	0
117	0	0	0	0
118	0	1	0	0
119	0	0	0	0
120	0	0	0	0
121	1	0	0	0
122	1	0	0	0
123	1	0	0	0
124	1	0	0	0
125	1	1	1	1
126	1	0	0	0

TOTAL OF BALTIMORE CITY = 6

TABLE A-4   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 4 - CONTINUED

ANNE ARUNDEL COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
201	1	2	2	1
202	2	1	2	1
203	1	1	1	1
204	1	2	2	1
205	3	2	6	3
206	2	2	4	2
207	2	1	2	1
208	3	2	6	3
209	3	0	0	0
210	3	1	3	1
211	2	1	2	1
212	2	1	2	1
213	3	1	3	1
214	2	1	2	1

TABLE A-4   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 4 - CONTINUED

ANNE ARUNDEL COUNTY - continued

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
215	3	2	6	3
216	2	1	2	1
217	2	1	2	1

TOTAL OF ANNE ARUNDEL COUNTY = 47

BALTIMORE COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
301	2	0	0	0
302	2	0	0	0
303	2	1	2	1
304	3	1	3	1
305	1	0	0	0
306	2	3	6	3
307	2	1	2	1
308	2	2	4	2

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TABLE A-4   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 4 - CONTINUED

BALTIMORE COUNTY - continued

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
309	3	1	3	1
310	2	0	0	0
311	2	1	2	1
312	1	2	2	1
313	2	2	4	2
314	2	1	2	1
315	1	0	0	0
316	1	1	1	1
317	2	2	4	2
318	2	0	0	0
319	1	1	1	1
320	1	1	1	1
321	1	2	2	1
322	2	1	2	1

TABLE A-4   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 4 - CONTINUED

BALTIMORE COUNTY - continued

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
323	1	2	2	1
324	1	2	2	1
325	1	1	1	1
326	1	0	0	0
327	1	2	2	1
328	2	0	0	0
329	1	0	0	0
330	2	0	0	0
331	2	0	0	0

TOTAL OF BALTIMORE COUNTY = 48

CARROLL COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
401	1	0	0	0
402	2	1	2	1
403	1	1	1	1

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TABLE A-4   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 4 - CONTINUED

CARROLL COUNTY - continued

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
404	1	1	1	1
405	1	1	1	1
406	1	1	1	1

TOTAL CARROLL COUNTY - 6

HARFORD COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
501	1	1	1	1
502	2	1	2	1
503	2	1	2	1
504	1	0	0	0
505	2	1	2	1
506	2	0	0	0
507	2	0	0	0

TOTAL OF HARFORD COUNTY - 7

TABLE A-4   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 4 - CONTINUED

HOWARD COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
601	1	1	1	1
602	1	1	1	1
603	1	1	1	1
604	1	1	1	1
605	3	3	9	3
606	1	1	1	1
607	3	1	3	1

TOTAL OF HOWARD COUNTY = 17

TOTAL SENSITIVITY INDEX X POPULATION IMPACT INDEX = 131

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TABLE A-4   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 4 - CONTINUED

BALTIMORE CITY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
101	0	1	0	0
102	1	2	2	1
103	0	0	0	0
104	1	0	0	0
105	1	0	0	0
106	0	0	0	0
107	1	1	1	1
108	1	0	0	0
109	1	1	1	1
110	0	1	0	0
111	0	0	0	0
112	1	0	0	0
113	1	0	0	0
114	1	1	1	1

TABLE A-5   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 5

BALTIMORE CITY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
101	0	1	0	0
102	1	2	2	1
103	0	0	0	0
104	1	0	0	0
105	1	0	0	0
106	0	0	0	0
107	1	1	1	1
108	1	0	0	0
109	1	1	1	1
110	0	1	0	0
111	0	0	0	0
112	1	0	0	0
113	1	0	0	0
114	1	0	0	0
115	1	0	0	0

TABLE A-5   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 5 - CONTINUED

BALTIMORE CITY - continued

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
116	1	0	0	0
117	0	0	0	0
118	0	1	0	0
119	0	0	0	0
120	0	0	0	0
121	1	0	0	0
122	1	0	0	0
123	1	0	0	0
124	1	0	0	0
125	1	1	1	1
126	1	0	0	0

TOTAL OF BALTIMORE CITY = 5

TABLE A-5   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 5 – CONTINUED

ANNE ARUNDEL COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
201	1	2	2	1
202	2	1	2	1
203	1	1	1	1
204	1	2	2	1
205	3	2	6	3
206	2	2	4	2
207	2	1	2	1
208	3	2	6	3
209	3	1	3	1
210	3	1	3	1
211	2	1	2	1
212	2	1	2	1
213	3	1	3	1
214	2	1	2	1
215	3	2	6	3
216	2	1	2	1

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TABLE A-5   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 5 - CONTINUED

ANNE ARUNDEL COUNTY - continued

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
217	2	1	2	1

TOTAL OF ANNE ARUNDEL COUNTY = 50

BALTIMORE COUNTY

301	2	0	0	0
302	2	0	0	0
303	2	1	2	1
304	3	1	3	1
305	1	0	0	0
306	2	3	6	3
307	2	1	2	1
308	2	2	4	2
309	3	1	3	1
310	2	0	0	0
311	2	1	2	1

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BALTIMORE COUNTY - continued

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
312	1	2	2	1
313	2	2	4	2
314	2	1	2	1
315	1	1	1	1
316	1	1	1	1
317	2	2	4	2
318	2	0	0	0
319	1	1	1	1
320	1	1	1	1
321	1	2	2	1
322	2	1	2	1
323	1	2	2	1
324	1	2	2	1
325	1	1	1	1
326	1	0	0	0

TABLE A-5   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 5 - CONTINUED

BALTIMORE COUNTY - continued

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
327	1	2	2	1
328	2	0	0	0
329	1	0	0	0
330	2	0	0	0
331	2	0	0	0

TOTAL OF BALTIMORE COUNTY = 49

CARROLL COUNTY

401	1	0	0	0
402	2	1	2	1
403	1	1	1	1
404	1	1	1	1
405	1	1	1	1
406	1	1	1	1

TOTAL OF CARROLL COUNTY = 6

TABLE A-5   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 5 - CONTINUED

HARFORD COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX x POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
501	1	1	1	1
502	2	1	2	1
503	2	1	2	1
504	1	0	0	0
505	2	1	2	1
506	2	0	0	0
507	2	0	0	0

TOTAL OF HARFORD COUNTY = 7

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TABLE A-5   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 5 - CONTINUED

HOWARD COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT AGGREGATED IMPACT INDEX
601	1	1	1	1
602	1	1	1	1
603	1	1	1	1
604	1	1	1	1
605	3	3	9	3
606	1	1	1	1
607	3	1	3	1

TOTAL OF HOWARD COUNTY = 17

TOTAL SENSITIVITY INDEX X POPULATION IMPACT INDEX = 134

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TABLE A-6 POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 6

BALTIMORE CITY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
101	0	1	0	0
102	1	2	2	1
103	0	0	0	0
104	1	0	0	0
105	1	0	0	0
106	0	0	0	0
107	1	1	1	1
108	1	0	0	0
109	1	1	1	1
110	0	1	0	0
111	0	0	0	0
112	1	1	1	1
113	1	0	0	0
114	1	1	1	1
115	1	0	0	0

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TABLE A-6   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 6 - CONTINUED

BALTIMORE CITY - continued

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
116	1	0	0	0
117	0	0	0	0
118	0	1	0	0
119	0	0	0	0
120	0	0	0	0
121	1	0	0	0
122	1	0	0	0
123	1	0	0	0
124	1	0	0	0
125	1	1	1	1
126	1	0	0	0

TOTAL OF BALTIMORE CITY = 7

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TABLE A-6   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 6 – CONTINUED

ANNE ARUNDEL COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
201	1	2	2	1
202	2	1	2	1
203	1	2	2	1
204	1	3	3	1
205	3	3	9	3
206	2	3	6	3
207	2	2	4	2
208	3	3	9	3
209	3	1	3	1
210	3	2	6	3
211	2	2	4	2
212	2	2	4	2
213	3	2	6	3
214	2	2	4	2
215	3	3	9	3

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TABLE A-6   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 6 - CONTINUED

ANNE ARUNDEL COUNTY - continued

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
216	2	2	4	2
217	2	2	4	2

TOTAL OF ANNE ARUNDEL COUNTY = 81

BALTIMORE COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
301	2	0	0	0
302	2	1	2	1
303	2	2	4	2
304	3	2	6	3
305	1	0	0	0
306	2	3	6	3
307	2	3	6	3
308	2	3	6	3
309	3	2	6	3
310	2	1	2	1

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TABLE A-6   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 6 – CONTINUED

BALTIMORE COUNTY – continued

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
311	2	3	6	3
312	1	3	3	1
313	2	2	4	2
314	2	2	4	2
315	1	1	1	1
316	1	1	1	1
317	2	2	4	2
318	2	0	0	0
319	1	2	2	1
320	1	2	2	1
321	1	2	2	1
322	2	2	4	2
323	1	3	3	1
324	1	3	3	1
325	1	2	2	1

TABLE A-6   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 6 - CONTINUED

BALTIMORE COUNTY - continued

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
326	1	0	0	0
327	1	3	3	1
328	2	2	4	2
329	1	0	0	0
330	2	0	0	0
331	2	1	2	1

TOTAL OF BALTIMORE COUNTY = 88

CARROLL COUNTY

401	1	1	1	1
402	2	1	2	1
403	1	1	1	1
404	1	1	1	1
405	1	1	1	1
406	1	2	2	1

TOTAL OF CARROLL COUNTY = 8

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TABLE A-6   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 6 - CONTINUED

HARFORD COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
501	1	1	1	1
502	2	1	2	1
503	2	2	4	2
504	1	1	1	1
505	2	2	4	2
506	2	0	0	0
507	2	0	0	0

TOTAL OF HARFORD COUNTY = 12

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TABLE A-6   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 6 - CONTINUED

HOWARD COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX x POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
601	1	1	1	1
602	1	3	3	1
603	1	2	2	1
604	1	3	3	1
605	3	3	9	3
606	1	3	3	1
607	3	3	9	3

TOTAL OF HOWARD COUNTY = 30

TOTAL SENSITIVITY INDEX X POPULATION IMPACT INDEX = 226

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TABLE A-6   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 6 - CONTINUED

BALTIMORE CITY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	SENSITIVITY IMPACT AGGREGATED INDEX
101	0	1	0	0
102	1	2	2	1
103	0	0	0	0
104	1	0	0	0
105	1	0	0	0
106	0	0	0	0
107	1	1	1	1
108	1	0	0	0
109	1	1	1	1
110	0	1	0	0
111	0	0	0	0
112	1	1	1	1
113	1	0	0	0
114	1	0	0	0
115	1	0	0	0

TABLE A-7   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 7

BALTIMORE CITY - continued

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
116	1	0	0	0
117	0	0	0	0
118	0	1	0	0
119	0	0	0	0
120	0	0	0	0
121	1	0	0	0
122	1	0	0	0
123	1	0	0	0
124	1	0	0	0
125	1	0	0	0
126	1	0	0	0

TOTAL OF BALTIMORE CITY = 5

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TABLE A-7   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 7 - CONTINUED

ANNE ARUNDEL COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
201	1	2	2	1
202	2	1	2	1
203	1	2	2	1
204	1	3	3	1
205	3	3	9	3
206	2	3	6	3
207	2	2	4	2
208	3	3	9	3
209	3	2	6	3
210	3	2	6	3
211	2	2	4	2
212	2	2	4	2
213	3	2	6	3
214	2	2	4	2
215	3	3	9	3

TABLE A-7. POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 7 - CONTINUED

ANNE ARUNDEL COUNTY - continued

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
216	2	2	4	2
217	2	2	4	2

TOTAL OF ANNE ARUNDEL COUNTY = 84

BALTIMORE COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
301	2	0	0	0
302	2	1	2	1
303	2	2	4	2
304	3	2	6	3
305	1	0	0	0
306	2	3	6	3
307	2	3	6	3
308	2	3	6	3
309	3	2	6	3
310	2	1	2	1

TABLE A-7   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 7 - CONTINUED

BALTIMORE COUNTY - continued

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
311	2	3	6	3
312	1	3	3	1
313	2	2	4	2
314	2	1	2	1
315	1	1	1	1
316	1	0	0	0
317	2	3	6	3
318	2	0	0	0
319	1	2	2	1
320	1	2	2	1
321	1	2	2	1
322	2	2	4	2
323	1	2	2	1
324	1	2	2	1
325	1	1	1	1

BALTIMORE COUNTY - continued

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
326	1	0	0	0
327	1	3	3	1
328	2	2	4	2
329	1	0	0	0
330	2	0	0	0
331	2	0	0	0

TOTAL OF BALTIMORE COUNTY = 82

CARROLL COUNTY

401	1	1	1	1
402	2	1	2	1
403	1	1	1	1
404	1	1	1	1
405	1	1	1	1
406	1	2	2	1

TOTAL OF CARROLL COUNTY = 8

TABLE A-7. POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 7 - CONTINUED

HARFORD COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX x POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
501	1	1	1	1
502	2	1	2	1
503	2	2	4	2
504	1	1	1	1
505	2	2	4	2
506	2	0	0	0
507	2	0	0	0

TOTAL OF HARFORD COUNTY = 12

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TABLE A-7. POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 7 - CONTINUED

HOWARD COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
601	1	1	1	1
602	1	3	3	1
603	1	2	2	1
604	1	3	3	1
605	3	3	9	3
606	1	3	3	1
607	3	3	9	3

TOTAL OF HOWARD COUNTY = 30

TOTAL SENSITIVITY INDEX X POPULATION IMPACT INDEX = 221

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TABLE A-8   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 8

BALTIMORE CITY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
101	0	1	0	0
102	1	2	2	1
103	0	1	0	0
104	1	1	1	1
105	1	1	1	1
106	0	1	0	0
107	1	1	1	1
108	1	0	0	0
109	1	1	1	1
110	0	1	0	0
111	0	0	0	0
112	1	1	1	1
113	1	1	1	1
114	1	1	1	1
115	1	0	0	0

TABLE A-8 POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 8 - CONTINUED

BALTIMORE CITY- continued

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
116	1	0	0	0
117	0	0	0	0
118	0	1	0	0
119	0	0	0	0
120	0	0	0	0
121	1	0	0	0
122	1	1	1	1
123	1	1	1	1
124	1	1	1	1
125	1	1	1	1
126	1	0	0	0

TOTAL OF BALTIMORE CITY = 13

ANNE ARUNDEL COUNTY

| 201 | 1 | 2 | 2 | 1 |
| 202 | 2 | 1 | 2 | 1 |

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TABLE A-8 POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 8 - CONTINUED

ANNE ARUNDEL COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
203	1	1	1	1
204	1	3	3	1
205	3	3	9	3
206	2	2	4	2
207	2	2	4	2
208	3	3	9	3
209	3	2	6	3
210	3	1	3	1
211	2	2	4	2
212	2	2	4	2
213	3	1	3	1
214	2	2	4	2
215	3	1	3	1
216	2	0	0	0
217	2	1	2	1

TOTAL OF ANNE ARUNDEL COUNTY = 63

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TABLE A-8   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 8 - CONTINUED

BALTIMORE COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
301	2	0	0	0
302	2	0	0	0
303	2	0	0	0
304	3	2	6	3
305	1	0	0	0
306	2	1	2	1
307	2	3	6	3
308	2	3	6	3
309	3	2	6	3
310	2	0	0	0
311	2	1	2	1
312	1	3	3	1
313	2	3	6	3
314	2	2	4	2
315	1	2	2	1

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TABLE A-8   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 8 - CONTINUED

BALTIMORE COUNTY - continued

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
316	1	1	1	1
317	2	3	6	3
318	2	0	0	0
319	1	0	0	0
320	1	2	2	1
321	1	3	3	1
322	2	1	2	1
323	1	3	3	1
324	1	3	3	1
325	1	2	2	1
326	1	0	0	0
327	1	2	2	1
328	2	2	4	2
329	1	1	1	1

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TABLE A-8   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 8 – CONTINUED

BALTIMORE COUNTY - continued

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
330	2	1	2	1
331	2	1	2	1

TOTAL OF BALTIMORE COUNTY = 76

CARROLL COUNTY

401	1	0	0	0
402	2	0	0	0
403	1	1	1	1
404	1	0	0	0
405	1	1	1	1
406	1	1	1	1

TOTAL OF CARROLL COUNTY = 3

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TABLE A-8   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 8 - CONTINUED

HARFORD COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
501	1	1	1	1
502	2	0	0	0
503	2	1	2	1
504	1	1	1	1
505	2	2	4	2
506	2	0	0	0
507	2	1	2	1

TOTAL OF HARFORD COUNTY = 10

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TABLE A-8   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 8 - CONTINUED

HOWARD COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
601	1	1	1	1
602	1	3	3	1
603	1	2	2	1
604	1	3	3	1
605	3	3	9	3
606	1	3	3	1
607	3	3	9	3

TOTAL OF HOWARD COUNTY = 30

TOTAL SENSITIVITY INDEX X POPULATION IMPACT INDEX = 196

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TABLE A-8 POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 8 - CONTINUED

BALTIMORE CITY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
101	0	1	0	0
102	1	2	2	1
103	0	1	0	0
104	1	1	1	1
105	1	1	1	1
106	0	1	0	0
107	1	1	1	1
108	1	0	0	0
109	1	1	1	1
110	0	1	0	0
111	0	0	0	0
112	1	1	1	1
113	1	1	1	1
114	1	1	1	1
115	1	0	0	0

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TABLE A-9 POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 9

BALTIMORE CITY-continued

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
116	1	0	0	0
117	0	0	0	0
118	0	1	0	0
119	0	0	0	0
120	0	0	0	0
121	1	0	0	0
122	1	0	0	0
123	1	1	1	0
124	1	0	0	0
125	1	1	1	0
126	1	0	0	0

TOTAL OF BALTIMORE CITY = 11

TABLE A-9   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 9 – CONTINUED

ANNE ARUNDEL COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
201	1	2	2	1
202	2	1	2	1
203	1	1	1	1
204	1	3	3	1
205	3	3	9	3
206	2	2	4	2
207	2	1	2	1
208	3	3	9	3
209	3	2	6	3
210	3	1	3	1
211	2	2	4	2
212	2	2	4	2
213	3	1	3	1
214	2	2	4	2
215	3	1	3	1

TABLE A-9   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 9 - CONTINUED

ANNE ARUNDEL COUNTY - continued

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
216	2	0	0	0
217	2	1	2	1

TOTAL OF ANNE ARUNDEL COUNTY = 61

BALTIMORE COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
301	2	0	0	0
302	2	0	0	0
303	2	0	0	0
304	3	2	6	3
305	1	0	0	0
306	2	1	2	1
307	2	3	6	3
308	2	2	4	2
309	3	2	6	3
310	2	0	0	0

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TABLE A-9   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 9 - CONTINUED

BALTIMORE COUNTY - continued

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
311	2	1	2	1
312	1	2	2	1
313	2	2	4	2
314	2	2	4	2
315	1	2	2	1
316	1	1	1	1
317	2	3	6	3
318	2	0	0	0
319	1	0	0	0
320	1	2	2	1
321	1	2	2	1
322	2	1	2	1
323	1	3	3	1
324	1	2	2	1
325	1	2	2	1

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TABLE A-9 POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 9 - CONTINUED

BALTIMORE COUNTY - continued

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
326	1	0	0	0
327	1	2	2	1
328	2	1	2	1
329	1	0	0	0
330	2	0	0	0
331	2	1	2	1

TOTAL OF BALTIMORE COUNTY = 64

CARROLL COUNTY

401	1	0	0	0
402	2	0	0	0
403	1	1	1	1
404	1	0	0	0
405	1	1	1	1
406	1	1	1	1

TOTAL OF CARROLL COUNTY = 3

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TABLE A-9   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 9 - CONTINUED

HARFORD COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX X POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
501	1	1	1	1
502	2	0	0	0
503	2	1	2	1
504	1	1	1	1
505	2	2	4	2
506	2	0	0	0
507	2	0	0	0

TOTAL OF HARFORD COUNTY = 8

TABLE A-9   POPULATION VERSUS SENSITIVITY IMPACT INDEX FOR ALTERNATIVE 9 - CONTINUED

HOWARD COUNTY

RPD	SENSITIVITY INDEX	POPULATION IMPACT INDEX	SENSITIVITY INDEX x POPULATION IMPACT INDEX	AGGREGATED IMPACT INDEX
601	1	1	1	1
602	1	3	3	1
603	1	2	2	1
604	1	3	3	1
605	3	3	9	3
606	1	3	3	1
607	3	3	9	3

TOTAL OF HOWARD COUNTY = 30

TOTAL SENSITIVITY INDEX X POPULATION IMPACT INDEX = 177